RECORDS OF THE
SURVEY OF INDIA
VOL. XX

THE WAR RECORD
1914 – 1920

PUBLISHED UNDER THE DIRECTION OF
COLONEL COMMANDENT E. A. TANDY, R.E.
SURVEYOR GENERAL OF INDIA

PRINTED AT THE GEODETIC BRANCH OFFICE,
SURVEY OF INDIA, DEHRA DUN, 1925.

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DEDICATED
TO THE MEMORY
OF THE OFFICERS
AND MEN OF THE
SURVEY OF INDIA
WHO GAVE THEIR
LIVES FOR THEIR
COUNTRY IN THE
GREAT WAR

PREFACE

THE whole Department may be justly proud of the remarkable War Record of the Survey of India, whose officers and men were able to prove their value in every theatre of the War. The bulk of our military officers were reverted to military duty soon after August 1914, and it has been impossible to note their varied services in the present volume, beyond giving a bare summary of casualties and awards. Others were employed in the great survey developments on the Western Front, but these operations are also omitted, as they have already been described in the "*Report on Survey on the Western Front, 1914-18*", published by the War Office.

The present volume also ignores much urgent and valuable work done in India by those who were left behind. It is therefore confined to a description of the surveys and explorations carried out by members of the Survey of India in Mesopotamia, Kurdistān, Macedonia, Arabia, Persia, Palestine, East Africa and Afghānistān. These explorations and surveys were accomplished in the face of many difficulties and in every variety of terrain, from the icy highlands of Central Asia to the waterless deserts of Persia and Arabia. The total area thus explored by members of the department, often in unknown and unmapped regions, is almost comparable to that of Europe, while reliable new surveys, based on fixed points, covered an area more than twice that of Great Britain. In the limited compass available it has only been possible to indicate a fraction of the varied adventures, privations, and technical triumphs, of all the scattered parties and individuals who contributed to this great achievement, which forms a unique chapter in the annals of surveying.

The following are a few of the points which may prove of particular interest to the student of war and the general reader. On pages 11 and 12 will be found some interesting information as to the long night-march of over 20,000 men to the Dujailah Redoubt in Mesopotamia, of the 7th/8th March 1916, in the account written by Major Mason, who was the survey officer detailed to guide the columns. If the opportunity presented by this very successful night-march had been promptly seized, Kut would almost certainly have been relieved, and the Empire might have been saved from the necessity of maintaining over half a million of men in a secondary theatre of war; anything which can throw light on the exact circumstances at this critical moment is most important to the soldier and the historian.

The survey operations in Mesopotamia, described in Part I, were so extensive and complicated that they necessarily present more difficult

reading than some of the personal adventures of small detachments or individuals pushed off into "the blue"; such as those of Major Perry's party with a mutinous Russian army in Western Persia (vide Chapter IX); or the daring and successful diplomatic mission of Khan Bahadur Sher Jang into the remotest fastnesses of Kurdistān (pp. 40-44); with their records of the ghastly desolation left by the War amongst a great rural population which had been almost exterminated by the combined operations of the Turks and Russians. The dash of the Dunsterforce to the Caspian Sea (Ch. X), again, gave Major Rich and his surveyors all the adventures they wanted, and resulted in our enjoying the temporary assistance of Russian ladies as "draftsmen" of the Survey of India. Major Mason (vide pp. 48-50) also led the first party which ever crossed the desert from Mesopotamia to Damascus in motor-cars; and Major Lewis' connection of the triangulation across this gap to Aleppo was a great technical triumph, while its close accordance in connecting with Egyptian surveys (vide pp. 44-48) showed the high order of accuracy maintained in our Mesopotamian framework. This Mesopotamian survey constitutes by far the largest portion of our survey record, but the volume itself must be left to indicate the extraordinary difficulties in which large parts of this work were carried out, and the patience and skill with which they were surmounted. Colonel F. W. Pirrie, C.M.G., C.I.E., I.A., who was in charge of these operations almost continuously from the beginning to the end, set a most soldierly example by his endurance of hardship, his determination in the face of difficulties, and his readiness to tackle every kind of work with his own hands, whenever the occasion offered. I may also note that the enormous improvements effected by Colonel Wood, R.E., in the survey situation in Salonika, are hardly brought out sufficiently in the modest report from which Chapter XII was partly compiled. Many of the other accounts also are liable to the same defect, in that the facts have only been obtainable from officers reluctant to turn the limelight on to the right spot.

Compilation and Authorship. The whole work has been thrown into its present readable form by Major K. Mason, M.C., R.E., in consultation with Colonels Wood, Gunter, and myself, together with various officers concerned, to whom he had to make special references. Amongst these, he asks me to mention Dr. de Graaff Hunter, M.A., Sc., D., our Mathematical Adviser, who is so frequently our mainstay in mathematical difficulties and who has again lived up to his reputation, both by his active service in Mesopotamia and by his assistance in disentangling many knotty points in connection with technical details recorded in this volume.

We are however most indebted to Colonel Pirrie, who voluntarily undertook the very heavy labour of compiling an exhaustive report on the whole of the survey operations in Mesopotamia, of which he alone possessed a complete and first-hand knowledge. This work has formed the indispensable basis of Part I of the present volume, but Colonel Pirrie, found it impossible to complete it until after his retirement in 1922.

Since then we have had to await an officer with the skill and enthusiasm of Major Mason, who was ready to undertake the heavy labour of summarising all this varied material in addition to his normal duties. The work really required an officer to be placed on special duty for the purpose, but we have been very shorthanded since the War, and the whole Department owes its lasting gratitude to Colonel Pirrie and Major Mason for this very valuable service. We can only hope that the quality of the resultant volume will in some measure make up for its rather belated appearance.

The Military Record. Since the volume itself is practically confined to the survey side of our War Record, after the majority of our officers had been reverted to military duty, it seems desirable for this preface to indicate briefly the conspicuous success with which these officers played their part as a military reserve, when thrown into the field with every variety of unit.

Of the fifty-four regular military officers in the department at the outbreak of War, the seventeen seniors were at first retained in India to carry on departmental work and to serve as a reserve for frontier or trans-frontier survey requirements. Of the remainder about a quarter were Indian Army officers who were reverted to their regimental depots, and who were for the most part employed there without opportunities for distinction. This left about 27 majors, captains and subalterns of the Royal Engineers who were sent off between August and October 1914, Major McHarg to East Africa, and the rest to England and France, where the seniors were mostly given command of R.E. Field Companies in the newly raised armies, while the juniors were posted forthwith to Field Companies on the Western Front without further training.

Eight of these officers were killed in action and eleven wounded. Obituary notices of those killed may be found on page 113, et seq., while their photographs appear in the Frontispiece. Since military recognition does not come easily to the surveyor, it was the survivors of those employed on purely military duty who won the greater part of the awards detailed in Appendix IV, which may be summarised as follows:—2 C.M.G's.—2 C.I.E's.—11 Brevets—16 D.S.O's. and Bars—3 O.B.E's.—7 M.C's. and Bars—9 Foreign decorations—67 Mentions in despatches and Special mentions—Total 117. This list does not include 66 awards granted to Class II officers, surveyors, &c.

Much more might be said of the exceptional military services of some of these officers, but the above abstract should suffice to show that the Survey of India affords an excellent training for R.E. officers, even in a military sense, and this fact is well worth noting at a time when we can see little chance of ever being able to reinforce other branches of the Corps to the same extent again. On the one hand our military cadre is reduced and short-recruited, while on the other hand the survey developments resulting from the War have enormously increased the complexity and extent of the services required of the surveyor under modern war conditions. It is therefore possible that we may have to

mobilise all our available R.E. officers for survey duties, in the event of a widespread emergency, with none to spare for other services.

The R.E. officer, in every branch, is apt to be everybody's servant *but nobody's child.* His hard-won successes are often taken for granted, without much thought for the difficulties surmounted, while his failures, however inevitable, are not buried out of sight, either in 'files' or in graves, but remain sticking out for all the world to scoff at. This is rather particularly the case with the surveyor. Who cares today about the extraordinary efforts and able organization involved in keeping the Army supplied with up-to-date maps when racing for Baghdad, as was accomplished by Major Gunter's compilation section (vide p. 21)? or for the high professional skill shown by Major Beazeley in inventing a new method of reconnaissance from aircraft, and his great physical energy in carrying it out in circumstances where it proved invaluable (vide pp. 33, 34)? I need not multiply such instances which can be found in all parts of this volume. It is indeed only when the surveyor is absent, and no maps are available, that his unique value and indispensability, in every kind of military operations, are properly realised.

The Anglo-Indian and domiciled European officers of our Class II Service (up till lately known as the Provincial Service) in many cases rendered valuable military service, though the bulk of them were required to carry on departmental work in place of military officers reverted to military duty. We have also a proportion of very good Indian officers in this Service, who were invaluable in assisting us to carry on necessary survey work during the War, but who had not the same opportunity of throwing themselves into the ranks, or otherwise gaining commissions, as noted in the following instances of military distinction :—

Messrs. Collins, McInnes, and Miller enlisted in England, and rose from the ranks. The first named was subsequently killed in France. Messrs. Tresham, Drake, O'Sullivan, Grant, Smith and Grice went to East Africa in 1914 with the Mussoorie Volunteers. The first named rose to be a Major while the second won the D.C.M., and both received regular commissions for service in the field.

Altogether fourteen officers received awards on active service while twelve were mentioned in despatches. The following seventeen officers received commissions in the British or Indian Armies, and rose to the ranks shown :—

Majors J. H. Williams, and C. H. Tresham, Captains H. B. Simons, V. P Wainright, C. B. Sexton, J. O'C. Fitzpatrick, and F. E. R. Calvert, Lieuts. L. B. Fitz-Gibbon, V. D. B. Collins, A. J. A. Drake, D.C.M., W. J. B. Miller, R. B. Gildea, C. S. McInnes, W. P. Hales, R. M. Wyatt, A. J. Moore, A. V. Dickson.

The Indian surveyors. Although they had no opportunity of establishing a purely military record, and their various services are duly recorded in the present volume, the whole Department will wish me to offer a cordial tribute to the fine soldierly spirit and devotion to duty

displayed by many Indian Surveyors, and other subordinates, in the face of prolonged hardship and isolation, interspersed with moments of extreme peril; and to their tact and good sense when working alone amongst all sorts of alien and unfriendly peoples. They were often able to secure valuable results in circumstances which would have paralysed the surveyors of almost any nation, and in the whole world there is no body of men so well adapted to facing the peculiar difficulties of surveying in the wilder parts of Southern Asia. As examples of their soldierly spirit I may refer to the following episodes recorded in the present volume:—

The coolness and resource of surveyors Tula Ram, Purdil Khan, and Amar Singh, in effecting their escape after being taken prisoners by the Kurds during the rebellion; and their professional zeal in preserving their surveys during their captivity and bringing them back safely (p. 52).

The gallantry of surveyors Ghulam Rasul Khan, Muhammad Abdul Azim, and their khalasis, on the Doiran front in Macedonia, when engaged in surveying on the front line under continuous and heavy fire. For their coolness and gallantry on this occasion both surveyors were awarded the Indian Distinguished Service Medal, (p. 95).

In India, the depleted staff of surveyors, etc., carried on ordinary surveys, mostly under the executive charge of officers of the Provincial Service, but many survey demands of an unusual and urgent character had also to be met. These fell most heavily on the Map Publication Offices in Calcutta, which had to work at high pressure throughout the War, and were for the greater part of the time under the direction of Colonel C.H.D. Ryder, C.B., C.I.E., D.S.O., R.E. The Mathematical Instrument Office especially rose to the occasion with very signal success in improvising a great deal of very valuable work in connection with Ordnance and Munitions, in recognition of which a C.B.E. was allotted to the Officer in Charge, Mr. T. A. Ferrier, who was most ably seconded by Mr. S. Woodhouse. Much special work was also required from the Geodetic Branch, under the direction of Colonel Sir Gerald Lenox-Conyngham, F.R.S., R.E.; and the few other seniors finally left in India had of course to meet various unusual requirements with depleted resources. All concerned were very glad to welcome back to the Department Colonel R. A. Wauhope, C.B., C.M.G., C.I.E., R.E. who had retired in 1905 after an adventurous career in connection with transfrontier surveys, and whose wide knowledge of our Western frontier and of Persian and Arabic was very useful in the preparation of special maps.

The Surveyor General. It fell to the lot of Colonel Sir Sidney Burrard, K.C.S.I., F.R.S., R.E., to fill the anxious and difficult post of Surveyor General during this critical period. The Department owes to his leadership the great opportunities which so many enjoyed during the War. First of all he fully maintained the traditions of the Corps, in throwing all R.E. officers he could spare, and indeed more than he could safely spare, as soon as possible into the position where they wished to

be, namely the post of danger, on the Western Front. He similarly reverted a number of I.A. officers without delay to their regimental depots and facilitated the joining up for military duty of all other classes of officers, so far as they could be spared. Finally he so utilised the scanty resources remaining at his disposal as to meet all urgent survey requirements; thus enabling us to publish a War Record which must ever remain one of the proudest chapters in the "Records of the Survey of India".

E. A. TANDY,
Colonel Commandant,
Surveyor General of India.

Simla,
17th August 1925.

CONTENTS

LIST OF ILLUSTRATIONS

PHOTOGRAPHS BY COLONEL F.W. PIRRIE, LT.-COL. E.T. RICH, MAJORS J.D. CAMPBELL, K. MASON & W.E. PERRY, CAPTAIN T.M.M. PENNEY, AND LIEUT. A.J. BOOTH.

MAPS AND CHARTS (AT END)

Sketch-maps in text

INTRODUCTION

The Outbreak of War.

ON the first of August 1914, the Survey of India was pursuing its normal duties in recess. Some members were looking forward to the next field season; others hoped for leave. Two detachments were far afield; one under Lt.-Col. Ryder was peacefully delimiting and surveying the Turco-Persian Boundary in collaboration with Russians, Persians and Turks; the other under Major H. Wood was with Sir F. De Filippi's scientific expedition exploring and mapping the headwaters of the Yarkand river. Even the newspapers had hardly begun to get alarmed, though there were bazar rumours that the British were going to war with Russia. Then suddenly the world was in a turmoil.

At the outbreak the strength of the Survey of India was 55 Imperial, 148 Provincial and 37 Upper Subordinate officers. Of these thirteen Imperial and two Provincial officers were on leave in England, but twelve of the former were immediately recalled to India.

Personnel in Military Employ.

Before August was over, three Imperial officers of the Survey, Lieuts. R. L. Almond R.E., F. P. Nosworthy R.E., and H. M. McKay R.E., reverted to the Sappers and Miners. The rest sorrowfully watched them depart, fearing that the war would be over before their chance would come. At the same time, Messrs. V. D. B. Collins and C. S. McInnes of the Provincial Service, who were on leave in England, at once offered their services in any capacity, and after a short period in the ranks were given commissions in the new armies then being raised.

A large number of Imperial officers applied in September to the Surveyor General for permission to revert to military duty. Before the end of 1914, besides those already mentioned, two majors and twenty-two captains and subalterns were transferred to military duty; Major Wood and Colonel Ryder had not returned from Central Asia or the Turco-Persian Boundary work; four officers were still seconded and one was sick.

The Provincial Service had also been depleted to some extent by the departure of six officers with the Mussoorie Volunteer Machine Gun Detachment for East Africa in September, while thirteen more applied for and received commissions in the Indian Army Reserve of Officers early in 1915.

At this period, therefore, of the two senior services, there were only fifteen Imperial and about a hundred Provincial officers to carry on the work of the Survey of India; and of these, as will be seen from chapter I, a detachment had already been formed and sent to Mesopotamia.

In this war record of the Survey of India, it is not intended to relate the experiences of all those officers who served in a military capacity. Their services in every part of the world would fill a

second volume. Some went direct to France and ended their careers during those desperate early days in Flanders. Others in England trained the Sappers of the new armies and went to war with them; others again were sent to East Africa or Egypt. In the course of time fortune favoured some and left others in the lurch. As the war spread, these members of the Survey were scattered over the face of the earth. Salonika, North and South Russia, Gallipoli, East Africa, all the sectors in France and Belgium, Italy, Mesopotamia, Egypt, Syria, Persia and the Caspian shores, all were trodden. One commanded a brigade in North Russia, another commanded a Persian army, while a third who, amongst many other wounds, received a bullet through the heart, distinguished himself by driving pyjama-clad down Piccadilly in the Duke of Buccleuch's carriage.

But wherever he went, the training of the Survey officer served him well. It was on the Western Front that the army was not only supported by the best map service in the world, but was also able to improvise the new survey methods of flash-spotting and sound-ranging; and in the improvement and application of these methods, the Survey of India can claim a very large share. Those who wish to find the history of this phase of the Great War will find it fully written in the "*Report on Survey on the Western Front. 1914-18*".

Scope of the present volume.

The present volume deals entirely with mapping or reconnaissances in other fields. Survey work in war time is a very serious business. There are few incidents of humour. It is the soldier who facetiously christens his little bit of trench "96 Piccadilly"; it is the surveyor who puts it on the map and sees no humour in it. Theodolites, planetables and other survey paraphernalia are objects of intense dislike to the infantryman, for they attract the enemy's fire which disturbs the peace and quiet at the front. Such remarks in the trenches as, "Here comes Chupatti, the trick cyclist", are really quite a serious matter for "Chupatti".

No! There is very little humour in war for the surveyor. His map is generally required at least the day before it is asked for; and it is therefore always a race against time. There is no fund of anecdote in this history; only a plain record of the surveyor's work. If Mesopotamia looms large and occupies more than half the volume, it is because by far the greater part of the Survey of India's departmental energies was devoted to it. Before the war, our maps of this theatre consisted of two wriggly lines of river with the names of certain tribes of doubtful character on either bank. Now, though the country itself is almost as bare as it was before, the map is filled with features and heights.

Here anyhow, the surveyor can contemplate his work with satisfaction. For it is he who shows the possibilities of irrigation and development. It is he who, while others are solely devoting their energies to destruction, first sows the seeds of peaceful progress. It is often the surveyor who first notes the presence of coal and oil, the discovery of which leads to prosperity. And in a country like Mesopotamia, it is he who points out the site of buried cities.

Amateur archaeology was, in fact, the lighter side of the Mesopotamian campaign. The lighter side of a shade temperature of over 120 degrees is an easy matter. From the moment when he heard the first strains of the Mesopotamian alphabet:—

"A" was the apple that grew so they say,
In the Garden of Eden down Qurnah way,
Till Eve came along and ate it one day
And was thrown out of Mesopotamia.....

archaeology formed a background to the surveyor's mind. Before the war was over almost every possible site of historical interest had been put upon the map and now only awaits the spade of the patient digger. The planetabler may have made a few mistakes, but these were not always his fault and it is not easy to become an archaelogist at a moment's notice.

Nevertheless, the fact remains that it is the surveyor who has traced out the canals and ancient beds of the two great rivers of Mesopotamia. It is his discoveries that have led others who served there to seek out the ancient truths; and the Survey of India can claim to have given the first accurate map of Babylon's ancient prosperity.

The contents of this volume are divided into three parts. In the first the surveys in Mesopotamia are described; in the second, those in Persia; and in the third, the work of miscellaneous detachments and parties in various other theatres of the great upheaval is recorded. In each of these parts the chapters are arranged as far as possible chronologically, but in many cases a Persian detachment described in the second part originated as an offshoot from the central organization in Mesopotamia. This arrangement is unavoidable.

Comparison of Survey conditions in various theatres.

It is interesting to compare the different conditions under which the Survey of India was called upon to produce maps. The Mesopotamian operations were for a long time mainly confined to two definite lines, the Tigris and the Euphrates. Whether our operations were successful and we advanced, or whether we were defeated and driven back, these two rivers formed definite lines of movement. It was therefore possible to look ahead in a general way and frame a policy. This policy developed into the construction of main chains of triangulation along the principal rivers, strengthened, as time went on, in their weakest parts, connected across the desert where possible, and extended in various directions to act as a basis for future surveys.

In the account that follows it will be seen how these fundamental principles were observed. At each step of the advance, when new and unmapped areas were occupied, triangulation was either rushed through to the front, or work was commenced at the forward area and series were extended back to the base. In either case surveys were made concurrently with the triangulation, connecting chains across the desert were forged whenever the tribal situation permitted, and extensions were taken to the frontier. At the same time every endeavour was made to map the front by ground and air surveys, the separate organization of the Compilation Section rapidly producing the necessary military maps.

In East Africa, such ideal conditions did not exist. Here was a large unmapped country with no definite lines of movement. An enterprising foe could roam about at will. The initiative of the enemy commander, his will o' the wisp attitude, and his capacity for dashing into unexpected and unexplored districts, gave the surveyor no time to make a scientific framework. All he could do was to join in the general chase, carrying on rapid route traverses in the vain hope that Von Lettow would double back on his tracks. In Salonika, the surveyor was more in his element. He had time, owing to the stationary condition of warfare, to base his work on scientific data and to complete large areas of accurate survey. But even here he had suddenly to throw down his heavy equipment and join in the hunt at the end.

The surveys on the L. of C. in East and West Persia could be carried out by more or less normal methods. The triangulation in both areas owed much to India and Mesopotamia for accurate origins. Nevertheless here time was always a vital factor, and tribal escorts, often composed of gentlemen whose whole lives had been given up to robbing their best friends, required an immense amount of tact.

Briefly it may be said, that the surveys of Mesopotamia had depth and no breadth; those in Macedonia breadth and no depth. In Mesopotamia the conditions were suitable for accurate geographical maps; in Macedonia they were more favourable for military surveys. But in East Africa with its great expanse of length and breadth, the surveys could make but little impression in the time available.

The Survey of Egypt was responsible for the mapping of Sinai, Palestine and Syria. A detailed account of the work in this theatre will therefore not be given. A Survey of India officer, however, found himself by the fortune of war attached to the Survey of Egypt, and a short resumé of his work has been included.

Not only was every kind of terrain surveyed, but almost every conceivable method of map reproduction was employed on one front or another. Men—and women—of various nationalities and races were trained as surveyors and draftsmen in order to meet the needs of the various armies.

Period covered and Outturn.

It has not been possible to conclude this history of the Survey of India at a definite date. Human nature is so constituted that, after several years of passion, it cannot regain normality at the stroke of a pen at Versailles. And in the East the negotiations were so drawn out, and eventually the terms were so unsatisfactory to all concerned, that the countries took long to settle down. The periods of the Kurdish rebellion, the Arab rising and the Afghān war have therefore been included in this volume.

It is difficult to summarize in a few words such varied conditions as those under which the Survey of India worked. Nor is it easy to tabulate the outturn of the many surveys and maps, on different scales. These results are therefore shown in tables and charts at the end of the volume. It is sufficient here to mention that the total area in various parts of the world definitely surveyed on the half-inch or larger scales by Survey of India personnel amounted altogether to nearly 180,000 square

miles during the period covered by this report. The whole of this work was scientifically executed and based on triangulation. In addition a great number of large-scale city plans, and many reconnaissances and route surveys on smaller scales were carried out. Maps of the whole of these vast areas have been compiled and published.

The maps of Mesopotamia have been connected by triangulation on the west to those of Egypt and Palestine, and on the north by Persia to those of Russia. These junctions were possible owing to the methodical way in which Colonel Pirrie organized his framework in Mesopotamia. The triangulation of India, by means of the work of the Eastern Persia Party, has also been extended to the Russian frontier north of Meshed. The three connections taken together are a great achievement.

Administration in India.

In India there was a vast amount of administration to be done in connection with all the detachments and parties on active service. Maps and plans were required for the troops retained in India, for cantonments and training purposes, and here the shrunken personnel of the Department put in a vast amount of good work with no applause. No request from Home or from any army in the field for personnel or equipment from the Survey of India was ever refused.

When the Department was almost denuded of officers in India, Colonel R. A. Wauhope C.B., C.M.G., C.I.E., R.E., who had retired from the service in 1906, offered to take the place of anyone younger than himself. His services were accepted. He worked for a period in Aden and then came to India.

Throughout the war the Department was administered by Colonel Sir Sidney Burrard, K.C.S.I., R.E., F.R.S., Surveyor General of India, whose period of service was extended. In looking through the number of letters and reports that form the basis of this volume, one is struck by the intimate interest he took in the welfare of every individual member of the various detachments on active service.

This record is dedicated to those members of the Department who gave their lives for their country. In the frontispiece will be found a Roll of Honour, while at the end there are brief records of the services of each officer who died. Lists are also given in the appendices showing the other casualties, and the various decorations and awards bestowed. These last amount in all to one hundred and eighty three; they bear witness to the value of the Survey of India in time of war.

In the volume, the work has been described under the name of each officer to whom that work was entrusted. It has not been possible to mention the humbler members of each party or detachment by name. Nor has it been possible to record in detail their many acts of devotion. But it should be mentioned here that Survey officers were throughout the war admirably supported by all who worked under them.

PART I.—MESOPOTAMIA

PART I.—MESOPOTAMIA

CHAPTER I

THE CONSOLIDATION OF THE SHATT-AL-ARAB

Turco-Persian Boundary Commission.

AT the outbreak of war with Germany, the Survey of India had a detachment under Lieut-Colonel C. H. D. Ryder, D. S. O., R.E., working with the Turco-Persian Boundary Commission. The frontier had been demarcated from Muhammarah to the neighbourhood of Urūmieh, when news was received on the 6th August 1914, that the British were involved in the Great War. As yet, Turkey was not immediately concerned, and the boundary work was hurried forward, friendly relations between representatives of all four countries being maintained. By the end of October, the final séance of the Commission was held in the neighbourhood of Ararat, just prior to the arrival of news that the Turks had bombarded the Russian ports on the Black Sea. The greater part of the British and Indian personnel had already left by various routes for India, but Colonel Ryder, who was acting as Deputy Commissioner, found it inadvisable to return through Persia or Mesopotamia, and he left for England by way of Baku, Petrograd and Archangel*.

There was no survey personnel attached to the military force from India which landed in Mesopotamia early in November, and it was not till towards the end of this month, that the Surveyor General received orders to despatch a section. By this time the Department had been much depleted by officers reverting to military duty.

Survey section lands at Basrah.

The plan of operations at the end of 1914 was, however, not ambitious, and the demand for survey personnel could be met without much difficulty. A small section was organized on the lines adopted for military expeditions on the frontiers of India. It comprised Lieut.-Colonel F. W. Pirrie, I. A., with surveyors Laltan Khan and Badan Khan, and disembarked at Basrah on the 27th December.

By this time the British were established on the Shatt-al-Arab. Basrah and Qurnah had been occupied, and the whole naval situation in the Persian Gulf had been rendered secure. The Turks, who had retreated to Amārah, had re-established themselves at Ezra's Tomb, some 22 miles above Qurnah, and both forces were watching each other for the next move.

The region now in British occupation was the whole Shatt-al-Arab delta. This river, which receives the waters of the Tigris and the

* An account of the work of the survey detachment on this Commission is given in *Records of the Survey of India*, Vol. IX p. 164 *et seq.*

Euphrates, is tidal. Throughout the greater part of its length, its banks are lined with groves of date palms restricting the view on either side for a distance of from one to three miles. These groves are intersected by irrigation channels of alluvial mud, in which the water level depends on that of the tidal river. The river banks are in almost all cases higher than the ground inland, and the surface in the cultivated areas and date gardens is generally below flood level. Here, small embankments, three or four feet broad, form the only means of moving dryshod from one place to another during periods of inundation. These are perforated at the bottom by wooden drains made with palm trunks, buried at intervals during their construction, and are therefore useless for keeping back flood water. Beyond the belts of palms, low-lying desert extends for many miles, and is also liable to inundation. It is covered with deltaic mud mixed with sand, quite hard when dry, but very difficult for wheeled transport and camels when wet. There are few landmarks, save occasional small mounds, from six to twelve feet high, so similar in appearance that it is difficult for anyone but a surveyor with a planetable to locate his position. The effect of mirage from 10 a.m. to 4 p.m. is to render distant low-lying objects invisible or to distort them in appearance; they are thus useless as landmarks. The Zubair-Shuaibah ridge, however, which rises thirty feet above the intervening plain, is very prominent; and west of Basrah, the buildings from Zubair to Imām Anas form useful landmarks.

4-inch Survey of Shatt-al-Arab.

The General Staff at once asked for a 4-inch survey of the palm-belt area on both banks of the Shatt-al-Arab from the Quarantine Station to Qarmat Alī, an area of about 23 square miles. This map was required urgently, especially that portion of it on the right bank between Khaura creek and Qarmat Alī, which contained the cities of Basrah and Ashār. The survey was put in hand, but only with sufficient detail and accuracy for laying out camps, roads and defences. While this Survey was in progress, the triangulation and detail surveys on smaller scales of the rest of the occupied area were taken up.

For the purposes of these 4-inch surveys, a graphic planetable traverse up the right bank of the river from the Customs House to Qarmat Alī, and back along the edge of the south-western desert was carried out; planetable sub-traverses connecting these two lines later divided the area into blocks. The numerous creeks and waterways, navigable at high tide by shallow water craft, gave a lot of trouble, as in many cases they were too wide for direct chain measurements. The whole right bank was divided into two main blocks, north and south of a line joining Basrah and Ashār cities, and 2nd Lieut. H. H. M. Spink, I. A. R. O., was lent to assist in the work.

The western portion of the traverses was laid out on the 6th January 1915. Large natural objects which could be picked up subsequently by theodolite triangulation were fixed, so that when the work was completed it could be oriented and fitted on to triangulated points. Both traverses closed without appreciable error.

At this stage Colonel Pirrie measured subtense-bar bases for theodolite triangulation, observing for latitude and azimuth at one end of

each base. He then extended his triangulation up the river to Qarmat Alī, as fixed points were urgently needed for a river survey of the Shatt-al-Arab and port of Basrah. Small military escorts were provided owing to the attitude of the local Arabs, and interpreters were employed to assist in obtaining the correct names of localities.

Commencement of triangulation.

After the completion of the triangulation to Qarmat Alī, it was extended across the south-western desert, points being fixed along the Zubair—Shuaibah—Imām Ānas ridge.

In order to be prepared for the flood season it was now necessary to ascertain the level of the areas allotted for supply and ordnance depots, engineer field parks, and the principal concentration camps. With this object in view, Lieut. Spink carried out a series of levels with a small theodolite.

Levelling.

The uncertainty regarding the whole scope of military operations in Mesopotamia, and the conflicting reports as to Turkish reinforcements, prevented any serious advance from Qurnah in January. Beyond the dispersal of a hostile gathering at Alūwi, some twenty-five miles north-west of Shuaibah, and the demonstration to the Rotah creek some eight miles up the Tigris, the situation remained stationary. The survey work was therefore able to proceed unmolested.

The small staff of the section, however, had difficulty in meeting the demands for surveys. In January, the military Governor of Basrah asked for large-scale surveys of the cities of Basrah and Ashār for house taxation and other municipal purposes. The most suitable scale appeared to be 48 inches to 1 mile for the town areas and bazars, and 16 inches to 1 mile for the surrounding suburban districts. It was evident that the work would entail great labour and care. General Barrett, however, agreed that the survey was a necessity, and Colonel Pirrie was asked to apply to the Surveyor General for extra personnel.

Large scale city surveys.

At the same time, in view of possible advances to Amārah and Nāsīrīyah, it became desirable to extend the triangulation as a basis for future surveys. A 4-inch survey of Qurnah was also required, and as the two surveyors were engaged lower down the river, Sowar Sanaullah Khan, 33rd Cavalry, was lent for the detail work.

Extension of Survey.

Qurnah is situated in a palm grove on the right bank of the Tigris immediately north of the junction of this river with the old channel of the Euphrates. On the opposite, or left bank of the Tigris is the village of Muzairah situated on open ground, but separated from the river by a palm grove. Both are built on ground artificially raised above the height of normal high river, but below that of an abnormal flood. The level of the ground near the river, as at Basrah, is slightly higher than that of the inland areas, and the ground slopes gradually down to the neighbouring swamps.

Colonel Pirrie arrived at Qurnah on the 28th January 1915, and ascended the Suwaib river in a naval gunboat on a survey reconnaissance three days later. A base was measured at Muzairah and observations for latitude and azimuth were carried out. Between Qurnah and

the Turkish position at the Rotah creek the whole country was a swamp, except for a few mounds on the right bank of the Tigris, of which "Norfolk Hill" was the nearest to Qurnah. In the course of the work, this hill was visited, but the view to the north was blocked by other low mounds further up the right bank. Without a subtense traverse, it was impossible to fix other points to the north unless suitable sites for stations on the left bank could be found. This was impossible, owing to low ground and high reeds, except in the neighbourhood of Muzairah. It was not until the force had advanced to Amārah that Lieut. McCraken, at the low river period in 1916, was able to carry his triangulation from the Rotah creek through Norfolk Hill and west of Qurnah to his stations on the old Euphrates channel.

Reinforcements.

In order to cope with the increased demands for surveys a request was made to the Surveyor General of India for reinforcements. In reply to this request three Indian surveyors and one computer arrived in Basrah during February, and Jemadar Hamid Gul joined from the Turco-Persian Boundary Commission.

The Floods, 1915.

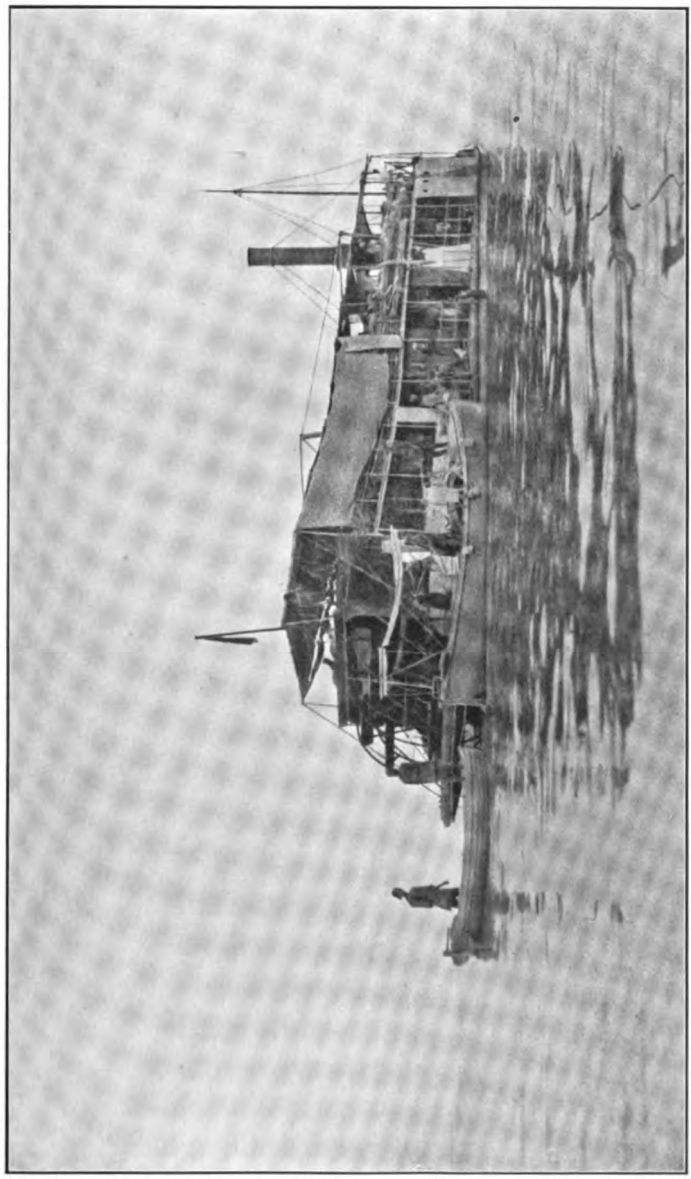
The floods began on the 20th February 1915, nearly a month earlier than usual, rendering military operations difficult, and interfering with survey work. From this date Muzairah and Qurnah became surrounded by a sheet of water, and there was great difficulty in keeping back the flood water from the fortified camp of Muzairah. A pontoon bridge was therefore thrown across the Euphrates at the junction south of Qurnah to enable the troops to be withdrawn to Qarmat Alī. The situation south-west of Basrah was also affected, and the whole area was under water, in places to a depth of three feet. This hampered the survey work in the direction of Shuaibah, as it tended to isolate the posts.

Daily escorts could usually be obtained for work near military camps, but in carrying out 1-inch or ½-inch surveys, the surveyor very soon completed the area within reach of the posts, often widely separated. Survey parties were not permitted to work without troops, and owing to the small military forces in Mesopotamia at that stage of the war, escorts sufficiently strong to protect isolated camps and the men at work could not be provided.

In March, owing to the activities of German agents and propaganda, the unrest in Arabistān and Southern Persia was growing. The situation here and the threat of large Turkish reinforcements advancing on Basrah, led to an increase of the forces in Mesopotamia. General Sir John Nixon arrived from India and assumed command of "Force D" on the 9th April. From this date Colonel Pirrie and the survey section worked directly under the orders of Major-General G. C. Kemball, and in close touch with G. S. O. I., Intelligence, Major W. H. Beach, R. E. All surveys were undertaken after discussion with the latter or his deputy, and with Sir Percy Cox, the Chief Political Officer, or his deputy, Captain A. T. Wilson.

The Admiralty's request to safeguard the Anglo-Persian oil supply now affected General Nixon's plans. The operations in Persian Arabistān

PLATE 2.



SURVEY STERN-WHEELER.
USED IN SWAMPS AND LAKE AREAS BETWEEN QARMAT ALĪ AND NĀṢIRĪYAH.

[to face page 4]

were intended to eject the Turks and to take the necessary protective measures while the pipe line was being repaired. The command of these operations was given to General Gorringe. Jemadar Laltan Khan, the only surveyor available, was provided with the data and maps of the Turco-Persian Boundary Commission Surveys, joined the column, and remained with it during the subsequent fighting.

Surveys in Arabistān.

Meanwhile the Turks had advanced and threatened Basrah. Severe fighting ensued at Shuaibah, with the result that the Turks suffered a heavy defeat and were driven far up the Euphrates.

The conditions at Qurnah were now very trying. The heat was intense and moist; the country was one vast expanse of water, with submerged palms in the neighbourhood of Qurnah, and miles of reed-beds and sandhill islands, held by the Turks to the north. Between these islands the depth of water was from one to three feet, but channels of varying size ran in every direction, and were quite indistinguishable in the general flood. It was only possible to extend the survey on the 1-inch and smaller scales near Zubair and Shuaibah, to push it forward along the northern desert in the direction of Chuwaibdah and Nukhailah, and to continue the surveys at the base.

Conditions at Qurnah.

On the 11th May, General Nixon issued definite instructions for an offensive up the Tigris. On the 31st, the enemy was attacked by the British in boats, and was driven headlong up the river. The pursuit was so vigorous that on the 3rd June General Townshend entered Amārah on the heels of the Turkish fugitives.

Occupation of Amārah.

During this exciting period every available fighting man was required for active operations and none could be spared for survey escorts.

In June, survey work became more and more impossible for both the surveyors and their escorts, on account of the mirage and the heat. Towards the end of the month, Sir John Nixon decided that in view of strenuous work required in the autumn, the survey section should be withdrawn to India, leaving behind two surveyors for essential military requirements. The section disembarked at Bombay on the 30th June 1915, Colonel Pirrie being on special duty in India during the next two months.

Survey Section returns to India.

CHAPTER II

THE FALL OF KUT

Formation of Basrah Survey Party.

DURING the absence of the survey detachment from Mesopotamia in 1915, the military situation underwent a radical change. The area of occupied territory increased, owing to the capture of Nāsīrīyah on the 25th July and to the subsequent advance towards Kut-al-Amārah in September. The extensive survey requirements therefore necessitated a much larger staff, and the Basrah Party was formed. Its composition was as follows* :—

Lt.-Colonel F. W. Pirrie, I. A.
Major H. H. Turner, R. E.
Captain W. E. Perry, R. E.
Lieut. J. McCraken.
" B. T. Wyatt.
" W. H. Strong.
8 Indian surveyors.
3 Indian computers.
1 Indian clerk.

The party disembarked at Basrah on the 17th September. Colonel Pirrie at once reported to Army Headquarters at Amārah, to ascertain the requirements of the General Staff. The programme finally approved was the triangulation and detailed survey of the following tracts :—

(*a*) Along the banks the Shatt-al-Arab and Tigris, from Fāo to Kut and to Nāsīrīyah along the Euphrates.

(*b*) Extensions into the adjoining deserts and swamps, as seemed locally necessary for the military operations and administration of the occupied territories.

It was decided to postpone survey operations on the Kārūn river and on the Shatt-al-Hai till a later date.

The O. C. Surveys then returned to Basrah, and distributed the triangulation and supervision of detail work as follows :—

Major Turner,	...	From Amārah to Alī-al-Gharbi.
Captain Perry,	...	The vicinity of Nāsīrīyah and thence towards Sūq-ash-Shuyūkh and the Hammar lake.
Lieut. McCraken,	...	From Amārah to Qurnah, thence to the Hammar lake to join with Captain Perry's work.

* Officers of the Provincial Service, Survey of India, were given the relative military rank of Lieutenant; those of the Subordinate Services had the equivalent military status of Subadar, Jemadar, Havildar, according to their standing in the department.

Lieut. Strong, ... Area between Basrah and Qurnah.
Lieut. Wyatt, ... Area between Basrah, Muhammarah and Fão.

Pre-war maps of Mesopotamia.

The only maps of the country available when the troops arrived in Mesopotamia in 1914 were the ¼-inch degree sheets of the Survey of India and the War Office sheets on the scale of 1/250,000. Both series had been compiled with great care, but from many sources of varied value, and were inconsistent in quality and amount of detail shown in particular localities. The navigation map of the Shatt-al-Arab and Tigris rivers by Lieuts. Gardiner and Hamilton, R.I.M., prepared in Turkish times under very great difficulties, did not extend beyond the actual banks of the rivers, and was of no use for land operations. The details of the river banks could not be depended upon, but as a general guide to navigation, distances and names of the reaches, it was of value.

The irrigation maps and plans of Sir William Willcocks, prepared for the Turkish Government on various scales, were of great use for particular purposes. They were not topographical maps, except as regards irrigation details, but were useful for obtaining ground heights, and details of localities where irrigation works were in existence or projected. Unfortunately, when these maps were found in Basrah, a great many of the most useful ones on the scale of 1/50,000 were absent from the portfolios.

The recent maps of the Turco-Persian Boundary were available, and also charts of the triangulation; these were of value along that frontier.

Half-inch scale selected.

The scale of half an inch to one mile was selected for field surveys in Mesopotamia and adjacent areas of Arabia and Persia after full discussion with the General Staff. This scale is normally used for similar purposes on the frontiers of India, and is the smallest on which physical features can be shown in sufficient detail without undue generalisation. The half-inch field surveys could be enlarged, and the maps published on the one-inch scale if considered necessary. It was also contemplated that larger scale surveys would be required in particular localities for various purposes.

General scheme of Survey.

The general plan of survey operations adopted from September 1915, was to measure local bases at the place where each triangulator started work, and to connect these by chains of triangles with each other. They were measured along the surface of the desert, and great care was taken in choosing each site, the ground being either flat or with a uniform slope from end to end, which was allowed for when computing the final value. The length, usually from 1500 to 5000 feet, depended on circumstances and the time available for measurement. Azimuths and latitudes were observed at one end of each base. The former were generally obtained by simultaneous vertical and horizontal angles to stars, while the latitudes were derived by circum-meridian observations to north and south stars. The data for computing the triangulation were an observed latitude, an observed azimuth, an assumed longitude,

and the measured base reduced to sea-level. This procedure enabled each block of triangulation and detail survey to be carried on independently, in order to produce local maps as soon as the detail had been surveyed Subsequently, the local triangulation and maps were all joined up and the longitudes converted to Greenwich terms. Major Turner and Captain Perry measured the first base of this description in September 1915.

Commencement of half-inch survey.

The triangulators and detail surveyors began work on various dates in October. On the 6th, Captain Perry and Lieut. Strong selected the site for a common base between the Euphrates channel and the Shatt-al-Arab south-east of Qurnah, and then left with their detachments for their respective centres at Nāsīrīyah and Basrah. The former reported to General Brooking, G. O. C., 12th Infantry Brigade, about the middle of the month. He found that the existing pre-war maps of the region showed practically no correct detail. Jemadar Laltan Khan, who had remained here during the summer, had done excellent work, but the area completed was small. The tribal situation was fairly satisfactory, but survey parties were not permitted to work more than a mile or so from the river. Further local surveys were urgently required and with a new base and origin, the triangulation was extended up and down stream. In November the series reached Sūq-ash-Shuyūkh by the right bank of the Euphrates, and crossing the river eastwards to the west margin of the Hammar lake, it closed at the "Haqiqa Post" (Akaikah) on the 10th December.

Early in January 1916, General Gorringe, who was commanding the forces on the Euphrates front, ordered Captain Perry to carry out a prismatic compass reconnaissance of the country on the northern shores of the Hammar lake. The inhabitants were hostile but the work was successfully concluded.

During the same period, Lieut. Strong completed the Basrah-Qurnah triangulation, while Lieut. Wyatt closed his series from Basrah at Fāo on the 14th January.

Lieut. McCraken, too, carried out his allotted task from Amārah to Qurnah by the end of November, having been able to take full advantage of the low water season. Continuing the work westwards from Qurnah, he connected the triangulation with Captain Perry's series from Nāsīrīyah near Akaikah on the 27th January.

There was thus by the end of this month one unbroken chain of triangulation from Fāo to Qurnah, from Qurnah to Nāsīrīyah, and from Qurnah to Amārah. Lieut. A. J. Booth, newly arrived from India, had also commenced work beyond Zubair and was working thence via Umm Qasr to Fāo.

Beyond Amārah, matters were not proceeding so smoothly. Major Turner, who, owing to his long experience of triangulation, had been given the section from Amārah to Alī-al-Gharbi, was progressing favourably, but the difficulties of obtaining escorts and the treacherous instincts of the Bani Lām Arabs were hampering his work.

General Townshend's attack on the Sinn position at the end of September, had led to the capture of Kut and to the rout of the Turks.

The pursuit had carried the British far up the river and was only broken off at Azīzīyah. Kut-al-Amārah, a very important place from a military point of view, is situated on the left bank of the Tigris. The Shatt-al-Hai at medium and high river takes off water from the Tigris on the right bank just below the town. In the vicinity there was much low ground, due to the existence of an old bed of the Tigris, which formed swamps and marshes during the annual rise of the river. It therefore appeared very important to start survey work at Kut as soon as possible, and instructions were received from the General Staff to do so.

First capture of Kut.

Colonel Pirrie himself took up the triangulation of this area, doubtless hoping that he would be in a position to secure escorts where the efforts of less senior officers might fail. He completed as much triangulation as possible with daily escorts—and without these, work was strictly forbidden. He then personally interviewed the Army Commander and begged for permission to extend his surveys. Sir John Nixon replied that a party camped away from Kut with a small military escort would probably be attacked by hostile Arabs, and that more troops would be required to extricate it. Colonel Pirrie then suggested working up river from Kut; this also was vetoed, on the ground that escorts could not be supplied till after the fighting at Ctesiphon was over. In order to triangulate up river from Kut, it would have been necessary to move from one to two miles away from the river banks, and in view of the hostility of the Arabs, this would have involved land escorts which were not forthcoming. Permission was obtained, however, to send survey personnel in the supply *mahailas* to Azīzīyah; there would be a small escort on each *mahaila* which would be towed up river all day by Arabs, tying up at night. It was then arranged to send two surveyors in the supply boats to Azīzīyah.

Attempts to survey Kut vicinity frustrated.

It is not suggested that the Army Commander could have done otherwise than refuse the necessary escorts, nor that he was insufficiently alive to the necessity for an accurate map of this vital area; the tribal situation, the small forces at his disposal, and the attenuated length of his communications, were all factors which doubtless influenced Sir John Nixon's decision. Nevertheless, as a result of this decision, it was impossible to make an accurate survey of the area between Shaikh Saad and Kut, and this explains why in January 1916 and during the subsequent desperate attempts to relieve Kut, the force was dependent on hasty reconnaissances and air-sketches. This explanation is all the more necessary since, at the time and subsequently, the writer, who afterwards served on the staff of the Tigris Corps, frequently heard the Survey of India unjustly criticised by staff and regimental officers for these inaccurate maps. The official history of this period of the campaign also alludes to the inaccuracies.

Colonel Pirrie completed all that was possible by the 11th November. With a locally measured base he fixed all *imāms*, minarets, and other prominent objects in the immediate neighbourhood of Kut. The value of this work as a later basis for air-photography and ground surveys, serves to show how priceless would have been a complete

survey based on fixed points.

The Battle of Ctesiphon.

Up till now fortune had attended every operation in Mesopotamia. The advance from the Persian Gulf had been one unbroken record of success. But towards the end of November a long period of disaster set in. It is not the intention of this history to record the military operations except in as brief a manner as is compatible with an understanding of the situation from a survey point of view. It is therefore sufficient to state that General Townshend's force attacked the Turks in position at Ctesiphon; that after a tactical success on the 22nd November, in which he captured 1300 prisoners, he found himself faced on the morrow without reserves by an overwhelming force of Turks; and that he was compelled to retire to Kut. The retreat was by no means unmolested, but the outskirts of Kut were reached on the morning of the 3rd December.

All available troops were now required to arrest the Turkish advance. Regular surveys beyond Amārah became still more confined to work in the vicinity of military posts than before, owing to the increased hostility of Arabs. Major Turner's section was therefore definitely closed down and he with his surveyors was placed at the disposal of the G.O.C. Tigris front for military reconnaissances.

The Investment of Kut.

General Townshend on his arrival at Kut took steps to withstand a siege. By 7th December, the investment was complete. The Turks made abortive attacks on various dates up to Christmas Eve, when severe fighting took place and they obtained a temporary lodgement in the defences. On Christmas morning, a counter-attack restored the situation. Three days later the Turks advanced to Shaikh Saad, which had previously been occupied by British cavalry.

On 6th January General Aylmer's leading troops got in touch with the Turks. On the 9th, the Turks retired from Shaikh Saad suffering heavy losses, and took up a new position north of and on the right bank of the "Wadi" river. They were attacked on the 13th January and after heavy fighting were driven five miles up river. Rain now fell at intervals, interfering with the operations and rendering the attack on the Umm-al-Hannah position a disastrous failure. It was after this battle that the relieving force heard from General Townshend that he could hold out till April. The respite thus granted permitted General Aylmer to reorganise his troops and to prepare for a methodical advance.

Need of accurate maps.

It was now that the need of accurate maps was felt. Major Turner at Tigris Corps headquarters worked hard at compiling maps from the very indifferent material available. Sapper officers were sent out with cavalry escorts to reconnoitre and sketch the ground. By the end of February, sufficient information had been obtained for General Aylmer to carry out his attempt to turn the enemy's right flank at the Dujailah Redoubt. The map for this operation, "T. C. 4", was compiled from various sources, the old pre-war small-scale maps of the river, sapper reconnaissances, air reports, and sketches of the ground inland. It is intended to enter into some detail as regards this map and its effect on the operation, for the official accounts tend to give the impression that

the inaccuracies of the map prejudiced success. This is not the case, as a critical study will show. It is considered too that any facts that tend to throw fresh light on the course of this disastrous action should be brought out, for the failure to relieve Kut at this juncture affected the whole history of the Eastern campaign.

The Battle of the Dujailah Redoubt.

The guiding of the night march was entrusted to Captain K. Mason, R. E., an officer of the Survey of India who had been on military duty with the Sappers and Miners since the early months of the war. He had already been on all reconnaissances of the ground carried out prior to the night of 7/8 March, and was therefore as fully acquainted with it as any one in the force. Nevertheless no reconnaissances by night had been feasible.

If 'T. C. 4' be superimposed on the later accurately surveyed half-inch map, it will be seen that the position of assembly, the point of divergence of column C, the position of deployment, and the Dujailah redoubt, are all correctly placed on the former, in respect to each other and to the compass. The column, therefore, if correctly led from the position of assembly, should have reached the position of deployment, via the point of divergence; and it did. The slight inaccuracy in the course of the depression, and the major errors of the Tigris bed did not affect the operation, except that the former may have tended to speed the march.

Official accounts state that the column reached a *bund* across the depression east of the point intended, instead of "the westernmost corner of the southernmost bend." The later surveyed map shows that the point reached, i. e. the bund, is in the north-west corner of square 41 b, which was the point alluded to in the corps order. The westernmost corner, is in square 41 a; this may have been intended, but it certainly was not ordered.

The guides and the head of the column reached this bund just before 6 a.m. Though it was no longer night, it was then still too dark to see the redoubt. * At this time, the greater part of the force was south of the depression in the open.

The Corps order stated, and verbal instructions to the guide were, that the column (i. e. its head) should be at the point of deployment by 6.15 a.m., *when it would deploy*. This latter operation by a large force takes time. The official account has overlooked this point and has interpreted the order to mean that the force should be deployed by 6.15 a.m. It appears that this very important consideration of the time to be occupied in deploying was not fully taken into account in the plan of operations.

Stress is laid in despatches and in the official history on the delays that occurred during the night march. The column was due to start

* This is amply borne out by the fact that at this moment a solitary light was seen burning in the direction of the redoubt. It was actually in the small Arab camp south-west of the redoubt nearly 4000 yds. away. Had there been light enough to make the redoubt "plainly visible", a lantern would not have been seen, nor would it have caught the eye, at this range. Nor if it had been day light would the bund have been "mistaken" for the western bank of a deep depression. If the westernmost point of the depression was intended, the force had still a quarter of an hour in which to reach it.

from the assembly point at 9 p.m.; it actually left at 10.22. Other delays are recorded and stressed. The reader gets the impression that these delays prejudiced success.

It is no function of a survey historian to criticize the conduct of a military operation; but as in this case there was a survey officer actually at the head of the column throughout, his evidence may be of value in any subsequent study of the operations. He does not believe that any delays in the march, nor any inaccuracies of the map had any effect whatever on the arrival of the head of the column at the time or place appointed nor on the subsequent disaster. Without those delays the force could have arrived earlier, but it must then have been halted in the dark, as it would have been almost impossible to deploy till it was fairly light. In the circumstances, the columns could have been deployed and ready for attack by 6.30 a.m. and in fact the leading troops of General Christian's column "A" actually were deployed about this time, but were recalled to the depression.

Fall of Kut.

The severe reverse that followed rendered further operations out of the question for some time. The Hannah and Falahīyāh positions were occupied in April, but the Sannāiyat position withstood all attacks. A final effort on the right bank of the Tigris only just missed success and a gallant attempt by "*Jalnar*" to run the blockade and take supplies to Kut was foiled. The last hope of the garrison was gone and the town surrendered on 29th April 1916 *.

Various factors affecting survey.

Both military operations and survey work in Lower Mesopotamia were largely dependent on the rise and fall of the main rivers. The banks are generally higher than the inland areas and require constant attention to retain the water as the rivers rise. The Turks and their Arab allies held the upper reaches of the rivers and were thus in a position to divert the water into adjoining areas of desert, thereby strengthening their defensive positions and hampering the attack. Another factor of uncertainty was the ancient feud between the cultivators who wished to control the rivers and canals and the nomads who brought flocks to graze on the rich grass which sprung up along the rivers if these were allowed to flood the plain. The interests of the two communities have always been directly opposed to each other.

If the country had been at peace, it would have been possible to survey the country in the first instance at the low water season, and to check the detail again as the rivers rose. This method would have ensured all topographical details being shown on the map, and areas liable to inundation could have been suitably marked. As it turned out, surveys had to be made when required, irrespective of the amount of flooding. As a general principle, every effort was made to survey all ground that was occupied as the force advanced, to extend the maps to the flank as far as possible, and to include such areas as were likely to fall within the scope of possible operations. It was also of great importance to survey an area in the first instance on the largest scale likely to be

* Jemadars Muhammad Khan and Badan Khan, of the Survey of India, were among the garrison and were taken prisoners. They were interned at Eski Shehr.

required, so as to avoid having to repeat the work. Though these principles were recognised, the difficulty of obtaining escorts as the force advanced, when more and more troops were required for actual fighting at the front, often prevented them from being carried out.

The O.C. Surveys kept in touch with the general situation as far as possible, and no work was undertaken unless it was considered of military value. When no surveys were possible at the front, schemes were submitted for work elsewhere; these were criticised by the general staff and classified in order of urgency. They were then referred to local military and political authorities, and arrangements regarding the strength and nature of escorts and transport were made. These were sometimes military and sometimes tribal, while in certain cases both kinds were used together.

Spelling of names.

A point of minor importance to the conduct of the war, but one which distressed certain experts, was the spelling of names. Both officers and men failed lamentably to distinguish between such letters as G and Q. However, the fiat went forth and the coughed-up guttural of Mesopotamia became the finished Q of polite Arabia. Magasis, the mud fort, became Maqassis, with visions of marble halls. Shaikh Gadban, the throat slitter, became Ghazban, the potentate! It became the duty of the Survey of India to keep its maps clean in this respect.

But when the frivolous soldiery busied themselves with the manufacture of new names, or sought out the authority of the Bible in christening small features in the desert with such names as the "Pools of Siloam", "Lot's Wife", the "Tower of Babel", and the "Pillar of Salt", the matter became more serious, and the Survey of India had to assume the duties of strict censorship. It was therefore with the utmost delight that the army found that Sodom and Gomorrah, those ancient cities of iniquity, whose charred remains are said to lie waste beneath the waters of the Dead Sea, had been born again in Mesopotamia. First entered on a 3rd Divisional sketch by a facetious reconnoitrer, they became accepted by the general staff and corps headquarters. Officers and men wrote home of the glories of the past. The fame of the rediscovered cities grew. More than a year afterwards, these names escaped the blue pencil in India and they found their way on to the 1/M sheet 2. Sodom had now become Fort Sodom; Gomorrah was Indianized to 'Gomarah'.*

Triangulation reaches forward area by Kut.

During the attempts to relieve Kut, the hostility of the Arabs prevented isolated survey detachments from working upstream of Shaikh Saad, but the triangulation was gradually brought up from Amārah to this point. In April and May, Major Turner triangulated east and west of Amārah and afterwards in the forward area of operations east of Kut. The various sections of triangulation between here and Amārah were at last completed on the 17th July. This series comprised observations by Colonel Pirrie, Major Turner and Lieuts. Strong and McCraken. The latter also observed a subsidiary series to the Persian foothills.

* At last in 1925, these names have been expunged from Indian maps. Their brief glory has departed, though they still have a certain vogue amongst the Germans, who always paid the Survey of India the compliment of copying its maps wholesale.

Surveys checked on Euphrates.

On the Euphrates front also survey work was checked. In January Captain Perry accompanied reconnaissances in force from Nāsīrīyah towards Shattrah-al-Muntafik, where the Shatt-al-Hai disperses itself in the desert. But after this the situation became more disturbed and detailed survey work on this front came to an end. Captain Perry's services were therefore put at General Brooking's disposal to assist the sappers, who were short of officers. For the next two months road improvements and flood protection on a large scale in the camps and Nasīrīyah city were some of the duties upon which Captain Perry was employed. Large working parties of soldiers and Arabs were employed, and often as many as two thousand coolies were working daily. A raised road was constructed towards Ur in order to provide a means of extricating the garrison of Nāsīrīyah, if it was flooded out, and to provide good communications with Basrah by the desert route. The floods reached a maximum during May, when the waters rose to within a few inches of the top of the embankments surrounding the camps, and extended as far as the eye could see. The danger was enhanced by the very high *shumal* winds, causing large waves which did extensive damage. There were many anxious moments, and the Royal Engineer and Labour Corps officers were for a fortnight called from place to place day and night, to repair the threatened banks. At last, on the 25th May, the floods began to subside.

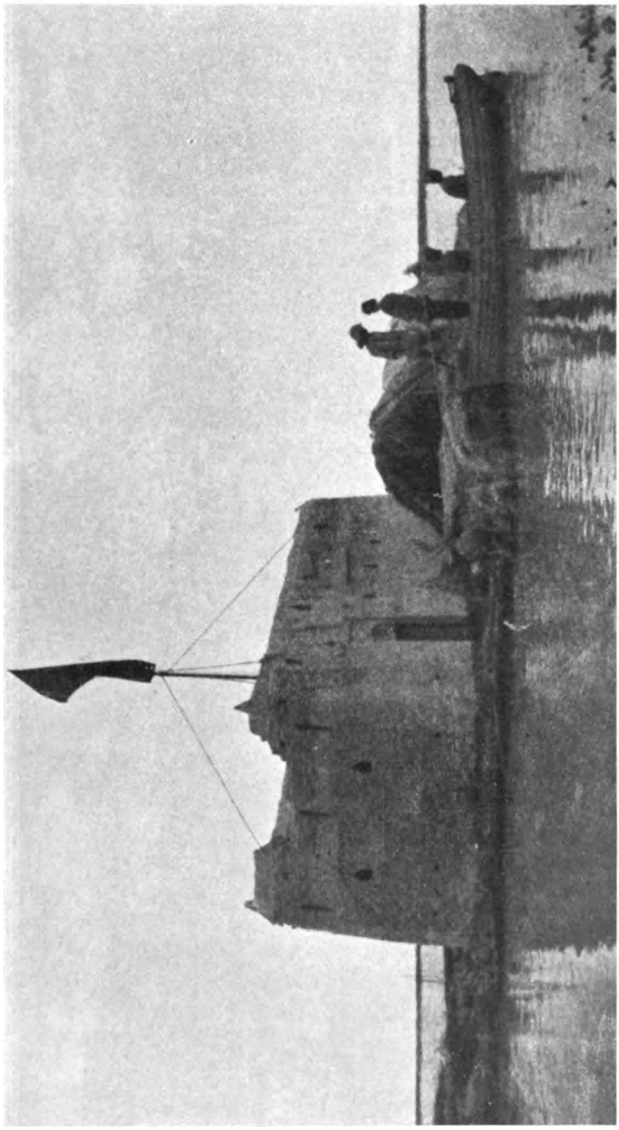
Survey extensions into desert and flooded areas.

In other parts of the occupied territory, where the situation was comparatively quiet, surveys were proceeding apace. The main river series of triangulation being finished in January 1916, extensions were made into the desert and flooded areas. The district west and north-west of Basrah was triangulated by Colonel Pirrie and Lieut. Strong, while Lieut. Booth took up the Basrah-Zubair-Rafdīyah series. The lake areas were very troublesome to deal with. Abū Khanzir, some 12 miles north-west of Qarmat Alī provided a central pivot station in the middle of the swamps. The depth of water varied from day to day according to the state of the rivers. There was open water in places with reed beds and islands just above flood level, upon which the marsh Arabs lived. These moved their villages to higher land as the water rose. It was difficult to use even small motor boats, as under-water weeds clogged the propeller, and most of the work had to be done in *ballams* or *mashufs* drawing from six inches to a foot of water. A motor launch channel was laid out from Harir village near Qarmat Alī to Abū Khanzir and from there to Alūwi and Ghabīshīyah. Soundings were taken, and direction was maintained by compass bearings. The surveyors set up their planetables in the water, the legs lengthened if necessary by bamboos. They themselves worked standing in *ballams*.

Triangulation was more difficult. In some instances, high wooden platforms were used, but these were not satisfactory. The mist in the early morning interfered with the view of distant objects, and later in the day, the heat, dust, haze and mirage made visibility difficult or impossible.

The attitude of the marsh Arabs sometimes gave rise to anxiety, and it was not always easy to gauge their intentions. The following

PLATE 3.



ABŪ KHANZIR (THE SALIMI TOWER)
THE SURVEY PIVOT STATION IN THE SWAMPS N.W. OF QARMAT ALI.

[to face page 14.]

incident may be cited.

Attitude of Marsh Arabs.

On a certain occasion Colonel Pirrie, Jemadar Laltan Khan, and an infantry escort of about 30 rifles, had arrived by boat one morning at a place between Ghabīshīyah and Tel-al-Lahm. After leaving most of the escort with the boats, they marched about two miles into the desert to search for a triangulation station. Some Beduin graziers, seeing the survey party, collected their sheep and drove them away towards the south. This act appeared suspicious, but hitherto the surveyors had had no trouble in that area. About 11 a.m., when visibility was getting bad, a large body of Arabs suddenly appeared in the distance, mounted and on foot. They approached within about 200 yards, when they were seen to be armed and carrying banners. Their intentions were not obvious, but Colonel Pirrie, thinking they looked hostile, ordered his small escort to take cover and get ready in case they were fired on. Then with the Jemadar he stood in a prominent place, while the interpreter shouted to the advancing crowd, which after some delay halted. After a further consultation among themselves the Arabs moved off, and the survey party and escort returned to the boat without being attacked. As the Arabs went away—there must have been at least two hundred—Colonel Pirrie noticed a few mullahs among them, and concluded that they were probably a band preaching *Jahad* or a religious procession. Had he opened fire, there would have been serious political trouble.

Storm effects in lake areas.

The following incident may be of interest to show the effect of a sudden storm in the water areas. A marine survey section under Captain C. S. Hickman, R.I.M., late of the Marine Survey of India, was employed in the sounding and buoying of channels for river transport. Colonel Pirrie on one occasion accompanied this section from Qarmat Alī into the Euphrates lake area, and had with him some personnel, kit and rations in three river *ballams*, one of which was fitted with an Evinrude motor. The marine survey section was well supplied with a steam launch, a motor launch, and several large rowing boats. When between Abū Khanzir and Alūwi there was a sudden storm, the whole lake became a choppy sea, and launches and boats were driven broadside on to the reed clumps in about five feet of water. It was only with difficulty that the laden *ballams* were kept afloat. The small Evinrude *ballam* in which were the two boxes containing the theodolite, became full of water, and there was only time to save one box and the Evinrude motor before the boat went to the bottom with the rest of the instruments. The launches and boats were scattered, but during the night the storm subsided. The next morning, none of the survey personnel was missing, but much kit and rations were lost during the night.

While the survey of these marsh areas was in progress, Lieut. Wyatt, who had completed a series on the left bank of the Shatt-al-Arab from Basrah to Fāo, made an extension from it at Muhammarah to Ahwāz, completing it towards the end of the April. He afterwards improved his Muhammarah-Basrah section by a desert connection north of the palm-belt. Lieuts. McCraken and Booth extended the triangulation to Kuwait about the same time.

By the end of July 1916 the outturn was:—

(*a*) *Area of Triangulation*:

Fāo to Kut-al-Amārah, Qurnah to Nāsīrīyah, Basrah via Zubair and Shuaibah to Ghabīshīyah, Basrah via Zubair to Rafdīyah, Umm Qasr and Fāo, and from Umm Qasr to Kuwait, Basrah via Muhammarah to Fāo and from Muhammarah to Ahwāz,	8,000 sq. miles.
(*b*) *Area of Detail Survey*, ½-inch scale, based on above triangulation.	6,800 sq. miles.
(*c*) *Area of Reconnaissance Surveys*, ½-inch scale, not based on triangulation.	2, 000 sq. miles.

The above does not include the city surveys of Basrah and Ashār, which were continued as surveyors could be spared from other work.

Approval of work.

In his despatch dated 12th August 1916, Lt.-General Sir Percy Lake, commanding the forces in Mesopotamia, wrote as follows:—

"The Survey Department has performed valuable, if unostentatious work, often under very adverse conditions".

In forwarding Lieut.-Colonel Pirrie's report to Army Headquarters in India, General Lake wrote as follows:—

"I request that after perusal the report may be passed to the Surveyor General, together with this covering letter.

"The report speaks for itself. I desire, however, to record my appreciation of the energy and zeal with which Lieut.-Colonel Pirrie has carried out the various surveys therein detailed, and the manner in which his staff and personnel have supported him under conditions, which, owing to climate and other considerations, have often been very trying.

"A noticeable feature of the work has been the entire absence of friction with the peculiarly uncertain elements of the population, settled and nomad, of the tracts surveyed; a fact which speaks as highly for the professional advice and assistance rendered by the Political Department as for the tact and intelligence exercised by the Survey Staff".

In June and July work became increasingly difficult for the survey staff and their escorts. Colonel Pirrie therefore received orders to leave Lieuts. McCraken and Booth with four surveyors in Mesopotamia, and to embark with the remainder at Basrah for Bombay.

Survey of marshes southwest of Amārah, June-August 1916.

During the absence of the survey party, Lieut. Booth and Jemadar Sijawal Khan were attached to the L. of C. at Amārah. After carrying out a survey of the defences on the 12-inch scale, two reconnaissances were made. In the first, carried out in June, Lieut. Booth and Captain Moore of the Intelligence Branch proceeded in armed motor launches up the Tigris as far as the Butairah channel. From here they reconnoitred this channel for about 40 miles in *mashufs*, returning by a circuitous route to Amārah three days later.

The second reconnaissance, with the Assistant Political Officer, was some fifty miles along the Mijar-as-Saghīr to Abid. On this occasion the A.P.O. and survey section were escorted by about 500 tribesmen in 100 *mashufs*. Half-inch reconnaissance surveys of the marsh country were done on both these occasions, planetables being used where possible in the open. Amongst the reeds, which were sometimes 20 feet high, only a prismatic compass and time sketch could be made, the distance being estimated by the rate of progress of the *mashuf*. The area surveyed was altogether 150 square miles. Jemadar Laltan Khan also did excellent work during the hot weather at Nāsirīyah, and returned to India on leave in August.

CHAPTER III

THE CAPTURE OF BAGHDAD

IN the last chapter mention has been made of the lack of accurate maps in the Kut area of operations during the attempts to relieve General Townshend. From February to June 1916, the compilation of sketch maps in this forward area was directly under the G. S. O. III (Maps) of Tigris Corps headquarters. Thus the "T. C. Series" came into being. The officer concerned had no technical experience whatever of surveying or reproduction.

Major Gunter organizes the Compilation Section.

During June, Captain Mason, R. E., was appointed to the post by Corps headquarters, but he only held charge for a few days before Major C. P. Gunter, R. E., who had also reverted from the Survey of India to military duty, arrived and assumed control. This officer at once settled down to organize an efficient section. From this moment to the disbanding of the Map Compilation Section in January 1919, the total number of pulls from machine and hand presses amounted to 1,491,540.*

The section entered into being as part of the Tigris Corps headquarters, but its work rapidly increased in technicality and in value, and it became essential to associate it more closely with General headquarters and the Flying Corps. The work assigned to it was primarily the compilation, drawing, printing and correction of all maps in the operation areas for immediate issue to the troops. Other work included the publication of plans and diagrams for various purposes by lithography and sun-printing, the facsimile reproduction of diagrams and drawings by photography or the Vandyke process, and the production of mosaics and enlargements of air-photographs.

The maps compiled and printed by this section for the force were:

(*a*) Geographical maps on the ¼-inch or smaller scales for strategical and general use,

(*b*) Topographical maps on the ½-inch or the 1-inch scales of areas of military operations,

(*c*) Operation maps on the 3-inch scale of areas in which attack or defence was in progress or expected, and

(*d*) Trench maps on the 6-inch and 12-inch scales.

These scales were fixed by Major Gunter and the Tigris Corps staff. Regarding the trench maps, the infantry favoured the larger scale, for defences could be reproduced exactly as they appeared on the photo enlargement. On the 6-inch scale the details of trenches, gunpits, machine gun emplacements, &c., had to be represented by conventional signs. On the other hand, for artillery purposes both battery positions

* For details see Appendix II.

and referring marks had to appear on the map, thus necessitating a very cumbrous sheet if on the 12-inch scale.

The organization and gradual expansion of the section was the constant concern of Major Gunter, and it is due to his untiring energy that the force in Mesopotamia was never again destitute of accurate maps for its operations. The work of this section, upon which all subsequent tactical plans were based, laid the foundations of success.

Air-photography and position maps.

The development of air-photography in other theatres was watched in Mesopotamia with envy. In the early days there were no machines available, and when a few arrived, they could not be spared for systematic photography. Early in 1916, however, a start was made, and some experience gained.

The introduction of position warfare in front of Kut emphasised the need of maps of the country behind the Turkish lines. Owing to the absolute flatness of the ground, it was only possible to survey or sketch the features up to "no-man's-land" by ordinary means. It was soon realised how valuable air-photography could be, if sufficient planes were available.

In April 1916, Captain Lawrence of the Egyptian Intelligence, while on a visit to Mesopotamia, had suggested the loan by Egypt of a section to assist in the compilation of trench maps from air-photos, based on the experience gained in Gallipoli and Sinai. The offer was gladly accepted. Pending the arrival of this section, Major Gunter had to make the best use of the apparatus at his disposal and to develop his maps largely from first principles.

Throughout the summer of 1916, by means of maps already brought out by the Survey Party, supplemented by air-photographs of the trenches taken at a height of 6000 feet, position maps were now compiled. The systematic photography of the enemy lines also became immediately necessary. Major Gunter suggested that one plane daily should be placed at the disposal of the mapping officer. Unfortunately this ideal was never reached, the plane deputed for the work being constantly taken for other duties, sometimes for days together.

A regular series of maps was laid out on one key-sheet, squared and numbered serially. Compilation of these was taken up in order of urgency. A system was evolved for the identification of points on the ground where there were no place names, and a list of symbols was drawn up. The Series continued to be known as the "T. C." (Tigris Corps) series, and this title was retained even after the corps had changed its designation to First Corps and after the extension of the area of operations to other fronts.

Triangulation by gunfire.

In order to tie together the air-photos of enemy territory and to maintain their correct scale, it was necessary to base them on a network of fixed points. The value of Colonel Pirrie's triangulation in the Kut vicinity, mentioned in the last chapter, was now apparent. This network, however, did not extend to the Suwādah lake area on the left bank of the Tigris, west of Sannāīyat, and another method of fixing points was evolved by Major Gunter in consultation with the artillery.

From four posts on the right bank of the Tigris, * all of which had been accurately fixed, observations to identical 6-inch howitzer shell-bursts on impact in the Suwādah position were made simultaneously. An observer in a biplane registered the position of each hit on a large scale plan of this portion of the trenches, compiled from air-photos. The observed angles with reference to the bursts and neighbouring posts were then plotted. Out of ten shots, three good intersected points were obtained, and one of these was marked "O. K." by the observer. This was accepted and formed the basis of adjustment of the photo-strips.

Trench maps.

By the end of October, the whole of the Turkish front from Sannāīyat to Shumrān to a width of five miles from the Tigris was mapped on the 3-inch scale. Trench maps of the Sannāīyat and Suwādah position on the 6-inch scale, and a second one of the Sannāīyat system on the 12-inch scale had been prepared. In all, an area of 160 square miles of country had been dealt with by air-photography. These maps were being kept up-to-date by correction and appliqué slips, † the closest touch being maintained with the Intelligence branch, with the front line troops and with the Flying Corps.

Arrival of Air-Photo Section from Egypt.

In November 1916, the section was moved to General headquarters at "Arab Village" and reformed into a complete Photo-litho section by the addition of a special air-photo section from Egypt. This brought with it a full photo equipment, and a flat-bed printing machine, which were welcome additions.

Battle of Kut.

During the autumn of 1916, General Maude had assumed command and had thoroughly reorganized the army in Mesopotamia. Various factors had led to an unopposed advance on the right bank of the Tigris, and by the end of the year every one was eager for the coming operations. These were designed to secure possession of the Shatt-al-Hai south of Kut; to clear the Turkish trench systems on the right bank of the Tigris; to sap the enemy's strength by constant attacks; by increasing his responsibilities along the river, to compel him to weaken all sectors of his front; and if he declined to loosen his grip at Sannāīyat, to cross the Tigris as far west as possible and so sever his communications.

From 5th to 19th January 1917, the preliminary fighting was severe but successful. From 20th January to 16th February intensive position warfare in the Hai salient south of Kut and in the Dahrah bend culminated in the complete loss of the right bank of the Tigris by the Turks. On the morning of the 22nd, the forward trenches at Sannāīyat were carried and maintained in the face of six furious counter-attacks. The following morning the 3rd Corps forced the passage of the Tigris in high flood at the Shumrān bend above Kut. The Turkish defence snapped, Kut was abandoned, and General Maude let loose his troops in hot pursuit.

* *Viz.* at Maqasis Fort, Chahailah Mounds, near Bait Isa, and at Crofton's mound.

† A correction slip consisted of a printed list of corrections and additions. An appliqué slip comprised a portion of the map brought up-to-date, so arranged that it could be pasted on the published map.

Pursuit to Baghdad.

The Turks were hunted from place to place, but managed to elude capture in bulk. The gunboats and the army raced up the river and its banks towards Baghdad. By the 5th of March, the leading troops of the 3rd Corps were again in sight of Ctesiphon; five days later the Turks made a final despairing stand below Baghdad. At last, as dawn broke on the 11th March, the leading battalion of General Cobbe's 1st Corps occupied Baghdad railway station and the city of the Caliphs was taken.

It is not easy for the soldier to change his trench outlook at once for the wide spaces of the open desert. But he had the exhilaration of pursuit to carry him forward, the lure of Baghdad to tantalize him, and above all the spirit of Kut avenged to dominate his being. From the 24th February to the 11th March, he covered some 120 miles and fought several actions. He gave no thought for the morrow. Has he ever wondered since at the extraordinary efficiency of the supply arrangements, for he rarely missed a meal?

Supply of maps during the pursuit.

Under the category of supply comes the provision of maps. But there is one important difference between maps and food. At a pinch a man can postpone his meal till after the battle, or consume the emergency ration which he carries. Stale bully beef, though nasty, is fit to eat. But a map must be fresh; it must be prepared at the last possible moment, so that it contains the very latest ingredients; and above all it must be "dished up" at the front before the battle is joined.

There were some hectic moments during the pursuit when the force almost had the satisfaction of saying "We have no maps". But such an eventuality never occurred, and on a certain occasion at the very moment when the Turks were chased off one map, an aeroplane hove in sight and dropped a welcome bundle of new maps at corps headquarters. The very greatest credit is due to the Compilation Section which slaved away day and night and produced such happy results.

A good deal of space has been devoted to this question of operation maps, partly because the section came into being as a separate entity from the Basrah Survey Party and partly because it was for the moment the most vital branch of survey organization. When Colonel Pirrie returned with the survey party in October 1916, he consulted the General Staff and together they wisely decided to keep the two organizations distinct. Mesopotamia was not overcrowded, and there was plenty of room and plenty of work for both. The ½-inch survey had been carried along the main waterways and adjoining areas to the front. It extended up the Kārūn river to Ahwāz and below Basrah to Fāo and Kuwait on the Persian Gulf. The total area on this scale already amounted to 8000 square miles, but there still remained a number of blanks on the map.

Major Beazeley's work in the forward areas.

Early in November 1916, the G. O. C. in Mesopotamia asked for a suitable survey officer to assist the artillery on the Tigris front, in obtaining ranges of targets. An energetic and resourceful officer was needed and Major G. A. Beazeley, R. E., was selected for the purpose. He came under the direct orders of the G. O. C. 3rd Corps, and was at first

employed on local surveys at Shaikh Saad and Arab Village, for the lay-out of supply and ordnance dumps. He also carried out reconnaissances with cavalry escorts, instructed junior cavalry officers in map-reading and field sketching, prepared range scales and artillery boards, worked out ranges to enemy targets and objectives for batteries in action, and fixed points for the control of air-photographs. In January 1917 he was employed on spirit levelling in the trenches, to assist in the precautions against flooding. When the troops commenced the pursuit, he left a surveyor at Shumrān and joined the 13th Divison at Umm-at-Tubul. He attempted to restart regular triangulation at Azīzīyah but failed owing to dust and haze. He therefore remained with the advanced troops and was of the greatest assistance to the gunners at the fighting on the Diyālah river from 7th to 10th March. He entered Baghdad on the 11th March with the 3rd Corps.

Captain Perry's Euphrates section.

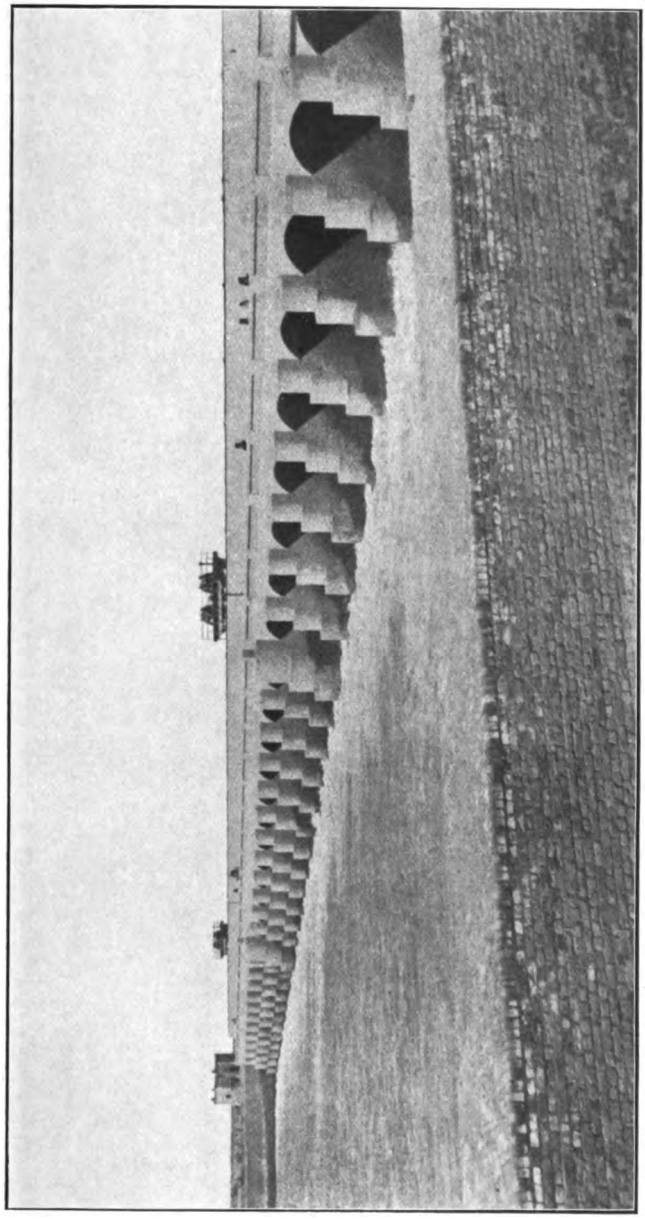
On his return to Mesopotamia with the survey party, Captain W. E. Perry, R. E., was again sent to the Euphrates front, where he triangulated in the neighbourhood of Ghabīshīyah. Then, after completing a 3-inch artillery map for the troops, he made reconnaissances and prismatic compass sketches of the desert in the neighbourhood of Tel Muqaiyir, the Biblical "Ur of the Chaldees". He also made a motor reconnaissance to Abū Sharain—the ancient Eridu—some eight or nine miles into the desert south of Ur. Triangulation and 1-inch surveys were also extended from the terminus at Ur southwards to Tel-al-Lahm and Khamīsīyah on both sides of the railway. In January and February 1917, the Euphrates detachment made three trips upstream from Nāsīrīyah escorted by a naval monitor, extending the survey for some thirty miles. On the capture of Baghdad, further 3-inch surveys on the Nāsīrīyah front were considered unnecessary, and Captain Perry moved with the 15th Division to Baghdad. He and his men had accomplished much useful work on the Euphrates since October 1915 under difficult conditions, and General Brooking, G. O. C. 15th division, spoke highly of the assistance he had received during the operations.

Surveys east of Alī-al-Gharbi and in Persian Arabistān.

In November 1916, a request for the survey of Persian Arabistān from Ahwāz on the Kārūn river up to Dizful and Shūshtar in the vicinity of the Anglo-Persian oil-field was made, and Lieut. McCraken started work at Ahwāz in the last half of the month. From October 1916 to January 1917, Lieut. Booth with Jemadar Sijawal Khan surveyed the waterless tract of country east of Alī-al-Gharbi, between the Persian foothills, the Duwarij river and the Tigris, an area of 1,600 square miles. Shaikh Juwi provided camel transport and the tribal escorts, an unruly crowd of men who squabbled and fought and frequently deserted. Drinking water was very scarce, as all local water was brackish, and it had to be brought from the Tigris as far distant as forty-five miles. The Tyb river in flood was crossed on a raft constructed of pakhals and bamboos by Jemadar Sijawal Khan. As usual, under such circumstances, Lieut. Booth showed himself resourceful in overcoming all difficulties.

During his surveys in the southern desert between Nukhailah and Luquait, Colonel Pirrie was asked to measure the amount of water in

PLATE 4.



THE HINDIYAH BARRAGE.

[to face page 22]

the principal wells and to examine the suitability of the surface south of the Basrah-Nasīrīyah railway for mechanical transport. The whole area was thoroughly traversed by motor lorry, and a report of the wells submitted to headquarters.

Col. Pirrie's desert reconnaissance.

In the meantime, systematic triangulation and detail surveys were being extended rapidly on the L. of C. and in Lower Mesopotamia. Many blanks had been filled up in the map, and original surveys made at high river had been improved.

From December 1914 to February 1917, the headquarters of the survey in Mesopotamia was at Basrah, where instruments, equipment and private kit were stored. At times clothing and stores had to be obtained from the depots at Basrah, while materials for the construction of survey stations and marks had to be purchased locally or obtained from the engineer field park. Early in 1915, the office was in tents near the Customs House, and later in an Arab house on the Ashār creek; while maps were reproduced in a separate building on the river front on the Shatt-al-Arab. Owing to the unsuitability of the contaminated river water for vandyking, the survey moved to Basrah city, where accommodation was better; but it was four miles from the Shatt-al-Arab and communication by means of the Ashār creek depended on the tide. At last a suitable office was obtained at Tanumah, on the left bank of the Shatt-al-Arab, opposite the Shaikh of Muhammarah's palace, the river water here being more free from impurities.

Location of Survey Headquarters.

By taking advantage of the political situation whenever possible, the survey of practically the whole area in our occupation in Southern Mesopotamia—to Kut on the Tigris, to Nāsīrīyah and beyond on the Euphrates, to Dizful and Shūshtar north of Ahwāz on the Kārūn, and from Umm Qasr to Kuwait on the Persian Gulf—was finished when the troops entered Baghdad.

Outturn to end of February 1917.

This satisfactory state of affairs was rendered possible by the judicious division of responsibility. While all the territory in British occupation was surveyed systematically by the survey party, the Map Compilation Section, working at Advanced Headquarters prepared all the operation maps from air-photographs and other material.

The area surveyed from the end of July 1916 to the end of February 1917, was as follows:—

(*a*)	Between Shuaibah, Hawīzah and Qurnah, ...	450 sq. miles.
(*b*)	Between the Karkhah and Shatait rivers, including Shūsh, Dizful, Shūshtar, and as far south as Ahwāz, ...	2200 sq. miles.
(*c*)	In the neighbourhood of Ghabīshīyah and Nāsīrīyah, ...	500 sq. miles.
(*d*)	South-east of Zubair, ...	250 sq. miles.
(*e*)	East of Alī-al-Gharbi, including the Āb-i-Chilat defile and part of the Dih-i-Lurān plain ...	1200 sq. miles.

The total area surveyed on the ½-inch or larger scales since 1914 was therefore 13,400 square miles. To this should be added the photo

survey and compilation under Major Gunter, the special work to assist the military operations done by Major Beazeley on the Tigris front, and by Captain Perry on the Euphrates front. The survey of Basrah and Ashār cities on the 48-inch scale was finished shortly afterwards. The 16-inch survey of the area near Basrah and Nahr Jubailah to Qarmat Alī in three sheets had been published, while that of the Makīnah area in four sheets was under reproduction.

In the covering letter, the C.G.S., on behalf of General Maude, wrote as follows:—

* * * * *

"I have the honour to request that the Surveyor General may be informed of my appreciation of the zeal and energy shewn by all ranks of the Survey Detachment under Lieut.-Colonel F. W. Pirrie".

In his despatch dated 10th April 1917, dealing with the operations to the end of March, General Maude wrote:

"The zeal and scientific knowledge evinced by the Field Survey Department is best exemplified by the fact that since the commencement of the campaign accurate surveys of an area of over 13,000 sq. miles of country have been produced, which have been of the greatest value to the Army".

CHAPTER IV

THE CONSOLIDATION OF BAGHDAD

Formation of Survey Directorate at Baghdad.

IN March 1917, Colonel Pirrie was ordered to move the headquarters of the Survey from Basrah and to form a Directorate at Baghdad. Establishment, stores and presses for map reproduction were brought up as shipping became available. The head of the Directorate was designated Deputy Director of Surveys, while the whole establishment became the "Mesopotamia Survey Party".

Headquarters were housed in the dilapidated Hospital on the left bank of the Tigris. This was patched up and occupied until the spring of 1918. The floors of the rooms were very unstable and the walls on the river front were cracked, but it was the most suitable building available. The question was raised by Brig.-General W.H. Beach, B. G. G. S., Intelligence, whether the Map Compilation Section should now be amalgamated with the Survey Directorate. Colonel Pirrie advised that it would be better to make no change then, and the former continued as a separate organization, supervised by Major Gunter and directly under the Intelligence Branch of Army Headquarters.

The personnel of the Directorate during this period comprised:—

Personnel.

Brevet-Col. F.W. Pirrie, I.A.
Major G.A. Beazeley, R.E.
Major L.C. Thuillier, I.A., from December 1917
Captain J. de Graaff Hunter, M.A., from Sept. 1917
Captain W.E. Perry R.E.
Lieut. S.S. McA. Fielding, from Sept. 1917
" C. West, from December 1917
" E.C.O' Sullivan, from Sept. 1917
" D.K. Rennick, from January 1918
" J. McCraken, invalided to India in June 1917
" F.C. Pilcher, June 1917 to Feb. 1918
" F.B. Kitchen, from Sept. 1917
" W.H. Strong
" A.J. Booth
" J.C. St. C. Pollet
Subadar N.C. Puri
" A.P. Ghosh
" H.C. Banerjea
" Bhamba Ram
22 Indian surveyors, 4 computers, 2 draftsmen, 3 clerks, 1 assistant prover.

Meanwhile the Compilation Section had followed Army headquarters to Baghdad a few days after the occupation; it was housed in a most

suitable building, where the underground '*sardabs*' provided cool and dustless press rooms. An engine was here installed for running the machine press.

The personnel of the Compilation Section was:—

Major C.P. Gunter, R.E.
Captain A.H. Gwyn, I.A., from Aug. 1917.
,, C.G. Lewis, R.E.
,, J.H. Cole, R.E.
(One Subaltern under instruction)
1 Warrant officer R.E.
27 British other ranks
19 Indian other ranks
12 Khalasis and 1 Carpenter.

Advances from Baghdad.

The army did not rest at Baghdad. Two days after the occupation, General Cobbe advanced to Mashāhidah up the Tigris, in order to control the river embankments to the north. At the same time on either flank other columns were pushed out. Bāqubah on the Diyālah and Fallūjah on the Euphrates were both occupied on the 19th March. On the Persian flank, the Russians were advancing by Kirmānshāh and Qasr-i-Shīrīn, driving the Turks before them. The enemy were momentarily expected at Khāniqin, and the British force at Bāqubah prepared to intercept them.

An event of considerable interest to the map-maker happened at the action of Mashāhidah. The maps north of Baghdad were at this period based on pre-war information, and the railway had been inserted from reports. The compiler had no means of knowing its true alignment, and assuming that in Mesopotamia nothing of importance is far distant from the rivers, he had shown it as clinging to within two miles of the Tigris.

Air observers reported the Turkish western flank astride the railway, *but failed to call attention to the inaccuracy of the map.* The attackers therefore, believing that they were within easy reach of the river, maintained direction by means of the railway. They found the flank and turned it, but at the end of the day, instead of being less than two miles from the river, they were nearly seven; and Turkish officers taken prisoners remarked that they had considered their flank, so far from the Tigris, to be safe from a turning movement. There is no doubt that the inaccuracy of the map in this case contributed towards success. *

The screen protecting Baghdad was now disposed approximately on the line Shahrabān-Mashāhidah-Fallūjah. On the right wing a junction was effected with the Russians under General Baratoff at Qizil Robāt on the 2nd April. The cavalry then moved forward in the vicinity of Dali Abbās. In the centre an advance was made up the Tigris and after further severe fighting, Samarrah was occupied on the 24th. By the end

* When mistakes occur in war, the map-maker often appears as a convenient scapegoat. This is a case where his errors might have received some measure of applause. As a matter of fact all the credit went to the fighting man and the map-maker was merely vilified because he had tantalized the soldier with the fiction that water was within easy reach.

of the month the Turkish 13th Corps had been driven to the Jabal Hamrīn and their 18th Corps to Tikrit.

Extension of Survey Responsibilities.

These victories led to a great extension of survey responsibilities. For not only was there the whole length of communications from Kut to Baghdad to be triangulated and mapped, but a connection from Baghdad to the Persian boundary, a second to the Euphrates, and a third to Samarrah, became desirable. At the same time, accurate operation and position maps of the new battle fronts were urgently required, in case of a Turkish counter offensive. There was thus ample work for both the survey organizations.

Surveys from the Baghdad origin.

A new temporary origin was located near Baghdad and the triangulation followed the forces to the three fronts. Major Beazeley had pushed out at once with the troops and made route surveys from Baghdad to Daudīyah. He then accompanied General Keary's column up the Diyālah, being present at the capture of Shahrabān and at the Jabal Hamrīn operations. In April, he joined the force operating on the left bank of the Tigris, determining ranges for the artillery, reconnoitring the Adhaim river as far as the hills and superintending the 3-inch map of the Sindīyah vicinity.

In the centre, the triangulation of the Tigris beyond Baghdad was taken up. Lieut. Booth worked with the 1st Corps and closed his series at Samarrah on the 14th May, while Lieut. Strong triangulated and surveyed along the Tigris from Qala Kermea to the Balad neighbourhood. Subadars Puri and Ghosh triangulated in the vicinity of Baghdad and up the Diyālah, and Lieut. McCraken from Bāqubah on this river towards Booth's terminal point at Samarrah. Meanwhile Captain Perry, who had arrived with the 15th Division from Nāsīrīyah, commenced a series from near Baghdad towards the Euphrates at Fallūjah. Near Khān Nuqtah he was much impeded by storms and floods caused by the breaking of the Aqqarquf embankment. He was subsequently withdrawn and placed in charge of the Western Persia Survey Party, which was formed to accompany General Baratoff's force. The work of this party is described in Chapter IX.

One more important chain of triangulation was also taken up. This was the connection of all this Baghdad work to the terminal points of the old triangulation at Kut. It was commenced in May by Subadar Ghosh, who worked down the river from the mouth of the Diyālah, and who completed it at Kut, towards the end of August.

Thus during the early days of the occupation period, Colonel Pirrie had organized a new centre of triangulation from which radiated series in all the main directions, while during the summer, this centre was firmly attached to the old chain.

While these various series of the framework were in progress, surveyors were hard at work on the detail. The planetable sheets, or traces of them, were forwarded to the Compilation Section, where T. C. maps were rapidly produced for immediate issue to the troops.

It was not long before reports were received at Baghdad of an intended offensive by the Turks during the ensuing winter. Not every

one believed these stories, but in the earnest hope that Falkenhayn would send his Turkish sheep to the slaughter, defensive positions were prepared for their reception. Great labour was spent on them and on their accurate representation on large scale maps. Major Beazeley, Lieut. Booth and eight surveyors worked on the position maps of the Istabulat trench system throughout the heat of May and June. Air-photographs were fitted to the triangulation, and the detail was identified and inked up on the ground, contours being filled in from a planetable survey.

Rumours of a Turkish offensive.

During June, July and the first half of August 1917, the heat was intense, so that neither the British nor the enemy undertook any extensive military operations. Early in June, Sir Stanley Maude received a communication from the Russians saying that they found it necessary to evacuate the line of the Diyālah river owing to the heat, and they subsequently withdrew beyond Karind towards Kirmānshāh*. This led to the occupation of Balad Rūz by the British on the 23rd June. Columns operated against tribesmen on the Euphrates early in May, on the Tigris in the middle of the same month, and on the Diyālah early in June and again towards the close. On 26th August, Shahrabān was reoccupied. During the lulls in the military operations, surveys were continued in spite of the heat.

Although Colonel Pirrie was much occupied with administrative work, he left Baghdad early in July and with Lieut. Strong carried out triangulation from Bāqubah to Balad Rūz and Mandalī. When at Balad Rūz he was asked to reconnoitre the desert to Azīzīyah and he proceeded in a Ford van with armoured cars as escort. The area was quite waterless and trackless; direction was maintained by watching the shadow of an object on the bonnet of the car; it was corrected from time to time by stopping and taking the back-bearing of the car tracks. Azīzīyah was hit off very well within a quarter of a mile in the total distance of forty miles. One of the armoured cars broke a back axle just before arrival, and this was promptly replaced from Baghdad. Two days later the armoured cars were required back without delay at Balad Rūz. Colonel Pirrie again guided them across the desert to the Diyālah, and then on to their destination, a total distance of sixty miles. A more trying time of the year could not have been selected for all concerned. The shade temperature was 126°, and there was but little reduction in the heat at night.

Balad Rūz to Azīzīyah Reconnaissance.

By the end of September all the surveys that were immediately necessary on the Tigris front had been completed, and survey operations were mainly concentrated in the Jabal Hamrīn direction, the Euphrates section also being strengthened.

Advantage was taken of the presence of the Western Persia Survey Party and the Anzac Wireless section at Kirmānshāh to obtain the mutual differences of longitude between Fāo, Baghdad and Kirmānshāh. Fāo telegraph office had previously been connected with Būshire by telegraphic longitude operations, by officers of the Turco-Persian Boundary

Wireless Longitude operations: Fāo, Baghdad, Kirmānshāh.

* See Chapter IX.

Commission. Būshire is one of the main longitude stations linking England and India so that the position of Fāo in longitude was already established.

It was arranged that signals should be sent from the central radio station at Basrah on the nights of the 10th and 12th October 1917. Colonel Pirrie observed at Baghdad, Captain de Graaff Hunter at Fāo, and Captain Perry at Kirmānshāh. Four pairs of east and west time stars were observed, both before and after the reception of the wireless signals. 'Calling up' started from the central radio station at midnight, Mesopotamian standard time, and after a pause the actual signals were sent in three groups of thirty signals, divided into sub-groups of five. The actual signal was the Morse code letter N— a dash followed by a dot—and the time of hearing the dot was recorded.

The probable errors of the positions of Baghdad Residency Flagstaff and of Kirmānshāh observation station in relation to Fāo telegraph office were found to be one second of arc in longitude, or about 72 feet. The final values of the longitudes as worked out by Captain de Graaff Hunter were as follows:—

Baghdad Residency Flagstaff	44° 24′ 17·6″
Kirmānshāh Time observation station ...	47° 4′ 23·9″
Fāo Telegraph office, Observation station on roof	48° 28′ 55·0″

To gain the full precision of which such observations are capable, it is necessary to determine the personal equations of the observers, but no opportunity of doing this occurred.

Astro-latitude observations at Baghdad.

Captain de Graaff Hunter also observed the latitude of the north end of the Baghdad base, obtaining the value 33° 21′ 35·5″ ± 0·3″. The values derived from the triangulation from Fāo to Baghdad, showed the following differences from the astronomical values.

A—G Latitude +4·1″. Longitude +10·2″.

First Operations of Winter 1917-18.

The first operation of the coming winter was on the right wing under General Marshall. By a strong flank attack, the Turks were dislodged from their position in the Jabal Hamrīn, a large portion of which was now captured. At the same time General Cobbe advanced up the Tigris against the Turks, who had reoccupied Al Huwaislat, eight miles north of Samarrah. Here, too, the operations were successful, Daur being seized on 2nd November, and Tikrit on the 6th, both after actions of some severity. The Turks, who had intended to make a stand, fled in disorder. On 19th November 1917, the news of the death of the Army Commander, Sir Stanley Maude, was received by the whole army and civil administration in Mesopotamia with the deepest regret. Under his leadership, the force had progressed from victory to victory, and all who came in contact with him regarded him with affection. All ranks of the survey owed much to his great interest and encouragement.

General Marshall, who assumed command of the army, pressed the operations vigorously. On the right wing, Qārā Tappeh was captured on the 6th December, and the Turks retired through Kifri. On the 8th, the troops were withdrawn from the forward areas on the Shahrabān front; but the Sakaltutan and other passes of the Jabal Hamrīn were held, a bridgehead at Qizil Robāt was established, and Khāniqin was

occupied on the 9th of December. On the Euphrates, Ramādi had been brilliantly captured in September and the position on this front had been consolidated. Hīt was abandoned by the enemy in February 1918, and on the 26th March, General Brooking attacked the Turks at Khān Baghdādi capturing the bulk of their forces. The remnants fled in disorder up the Euphrates, but very few escaped. Ānah was captured with much material on the 28th, and after destroying the large dumps of stores and ammunition, the force was again withdrawn to the neighbourhood of Khān Baghdādi.

Events on L. of C.

On the 21st of March 1918, the political officer at Najaf, Captain W. M. Marshall, was murdered for no apparent reason. Further down the Euphrates raiding parties were despatched during the winter to punish recalcitrant chiefs near Nāsīrīyah. During the same period the defences on the Tigris L. of C. proved very efficient, nothing worse than thefts occurring between Amārah and Qurnah. A force was maintained on the Kārūn river to protect the oilfields and pipe-line, as well as to maintain order at Ahwāz, Shūshtar and Dizful, while early in 1918 a small column reconnoitred the Persian road as far as Pā-i-Tak at the foot of the Tak-i-Gireh pass, in an endeavour to open up the trade route. On its return Qasr-i-Shīrīn was occupied.

Shortage of transport.

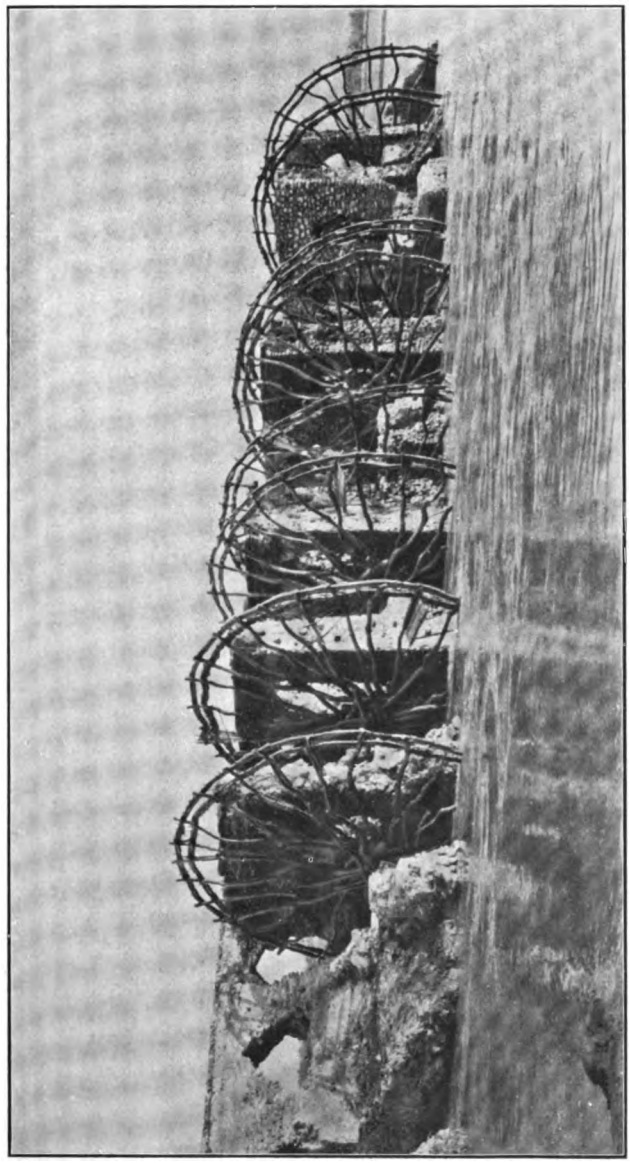
During the events mentioned above, every opportunity was seized to extend the surveys. The shortage of mechanical vehicles and the fact that surveyors and triangulators in the forward areas had no definite allotment of transport increased the difficulties of the local staffs. But the need for good maps was now firmly implanted in every commander's mind, and if there were any Ford vans available they were allotted to the survey.

Work on Shahrabān front.

On the Shahrabān front Colonel Pirrie, Major Beazeley, and Lieut. Strong were busy triangulating and supervising the 3-inch operation surveys, and the tactical surveys on the 1-inch scale. The triangulation was also used as a framework for air-photography, thus extending the maps into inaccessible regions. As new advanced lines were established, they were corrected by additional triangulated points and supplementary ground surveys. Lieut. Strong also extended his work to Khāniqin and Āb-i-Naft, an area which at the time was much disturbed. On the same front, Lieut. Booth supervised the survey on his own framework from Dali Abbās to Qārā Tappeh, to the Ain Lailah pass, and from here to the forward area near Umr Mandan. Subadar Puri was also working near Shahrabān, and in the Jabal Hamrīn to Mirjawah and Qārā Tappeh; while Lieut. O'Sullivan was triangulating in the Jabal Hamrīn towards Dali Abbās, on the Shatt-al-Adhaim, and west of the Diyālah.

All these surveys had made extensive progress when the course of the operations drew attention to the Kifri-Kirkuk area. The country here was so intricate that it was not possible to fix points far ahead into the area in enemy occupation; and without these, any form of air-photo survey was inaccurate. Subsequently an operation map was produced

PLATE 5.



WATERWHEELS ON THE EUPHRATES AT HIT.

[to face page 30

from Major Beazeley's air sketches*.

The occupation of Daur and Tikrit was too rapid for the triangulation to be extended continuously to the latter place. The greater part of the transport had been despatched from the Tigris to other fronts, and it was only with difficulty that any could be found for the surveyors. A rapid survey of the Tikrit position was however made before the troops fell back to Samarrah.

On the Tigris front.

During the winter, great strides were made in the survey of the Euphrates. Lieut. Pollet extended his triangulation to Karbala, southwest of Fallūjah, and then carried it forward up the river to Hīt and Sahilīyah. Great use was made of Willcock's irrigation heights for correcting the accumulated errors in the triangulated values, due to the effect of abnormal refraction. Lieut. Booth also triangulated on the Euphrates from Hīt to Khān Baghdādi for a short period.

Survey on the Euphrates.

Early in 1918, the survey staff on the Euphrates was strengthened by the addition of Captain Perry and Lieut. Rennick, who had now returned from Persia.† Captain de Graaff Hunter also, who had been working north of Baghdad, triangulated southwards to Musaiyib on the Euphrates and then back to the Tigris at Azīzīyah, thus making two additional connections between the rivers, and supplying points for the detail surveys of the desert area. He then worked in the Diwānīyah neighbourhood, replacing Captain Perry, who had been injured in a motor accident. Meanwhile Lieut. Rennick was surveying between Hillah and Diwānīyah, and Lieut. Kitchen from Najaf and Karbala across the western desert to Shafathah and Rahalīyah. Then extending his triangulation down the Euphrates from Najaf and Kufah to Abū Sukhair, the latter joined up with Major Thuillier's series from Nāsīrīyah. This officer had started work on the Euphrates above Nāsīrīyah in December 1917, extending from the terminal points of Captain Perry's work, described in the last chapter. His series was taken via Samāwah and Shināfīyah. Lieut. Fielding also, after surveying between Samarrah and Daur, on the Tigris, was sent to the Euphrates, where an experienced triangulator was required for the intricate areas under irrigation between Musaīyib and Hillah.

The situation on the Euphrates at this period was very unsettled, partly owing to the fact that the advance to Baghdad had taken the line of the Tigris, and partly owing to the activities of Turkish agents. There were constant rumours that the Turks proposed an advance in force down the Euphrates, and these had a disturbing effect on the tribesmen. The local Muntafik and the religious sects of the holy cities were peculiarly susceptible to these influences, and it is greatly to the credit of all the survey detachments concerned that the work was so efficiently carried out with such little friction. This measure of success was largely assisted by the personal influence of the political officer, Colonel Leachman.

* See Chap. V. † See Chap. IX.

Situation of Surveys at end of March 1918.

By the commencement of the hot weather of 1918, one year after the occupation of Baghdad, all the fronts were again connected by triangulation with the origin at Fão. Surveys based on fixed points were completed along all the main lines of communications and as far as the foremost areas. Position maps had been prepared on large scales in case the Turks grew obstreperous. Areas in enemy occupation had been air-photographed and operation maps had been compiled of these in case it was decided to advance. The surveys of Basrah and Ashār on large scales had been completed; from December 1917, Lieut. C. West was in charge of the work in this neighbourhood. A 12-inch map of Baghdad city had been produced from air-photos, fitted to a framework of points and supplemented by ground surveys. In addition to these normal duties, a sound ranging instrument had been jointly designed and constructed by Colonel Pirrie and Colonel R.D.T. Alexander of the London Scottish; the testing of Barr and Stroud Rangefinders had been taken up, and other matters of varying importance had been referred to and undertaken by the survey authorities.

In his despatch dated 15th April 1918, dealing with the winter operations, Lieut.-General Sir William Marshall wrote:—

"The work performed by the Survey has assumed very large proportions, but my demands have always been met in the most satisfactory manner; and the Map Compilation Section has been of the greatest assistance".

CHAPTER V

THE VICTORY AND THE ARMISTICE

THROUGHOUT the winter of 1917-18, Colonel Pirrie, Deputy Director of Surveys, had been suffering a good deal from rheumatism. No relief was obtainable in Mesopotamia, the pain became more acute, and sleep more difficult. Accordingly he was granted leave on medical certificate from the 1st May 1918. He was succeeded in Mesopotamia by Lieut.-Colonel C. H. D. Ryder, C.I.E., D.S.O., R.E.

Col. Ryder assumes charge of the Survey Directorate.

Before the hot weather set in, operations were carried out on the right wing, to force the Turks to withdraw from the Qārā Tappeh—Kifri—Tuz Khurmātu area. These places were occupied, Tauk was reached on the 5th May and two days later Kirkuk was entered unopposed. The main body arrived on the 8th and the Turks had all retired beyond the Lesser Zāb river by the 11th. Shortly afterwards troops were withdrawn for the Persian L. of C., only a small mobile column being left at Kirkuk.

First occupation of Kirkuk.

When preparations for the advance on Kifri were in progress, an operation map was urgently required; but there was insufficient time to photograph the area, so air sketching was resorted to. Major Beazeley had previously invented a system of fixing points and sketching detail from an aeroplane. After the 3-inch Jabal Hamrīn survey was completed, he began to teach his system to selected pilots of the R. A. F.; but these officers made little progress, chiefly on account of their unfamiliarity with survey methods. Major Beazeley's procedure was to select a suitable base inside the British area between two prominent well-fixed objects, and when flying over one towards the other to intersect on his sketching board easily visible points in enemy territory. These were chosen to form well-conditioned triangles with the original base, and from the new bases so formed, other forward points were fixed in the same manner. He designed and used a small sketching board on which was fixed a sun azimuth dial with a central shadow pin for orientation at the moment of intersecting the distant object—generally in the early morning when the sun was low above the horizon. Having obtained a rough network connecting these points and extending over the enemy area, he next proceeded to sketch in the detail when flying over the ground on his return, repeating the journey if necessary. This method of work only produced a very rough map, but it was far better than no map at all, or than the unsystematic eye sketches of the R. A. F.

Major Beazeley's method of Air sketching.

The original intention was that this kind of approximate sketching

would be carried out by the R. A. F. observers, to illustrate their reconnaissances; but as they were not sufficiently well trained the general staff now asked for Major Beazeley's services. The latter accordingly went up and compiled a sketch of the area in front of Kifri, sending it to Baghdad by plane the same evening. The Map Compilation Section immediately reproduced it and copies reached the troops at the front early on the following morning, when it was used in the advance on and capture of Kifri.

Major Beazeley shot down.

The success of this map led to a demand by the general staff for a similar one for the fighting towards Kirkuk. Major Beazeley accordingly was sent up again. Unfortunately, the plane was brought down by rifle fire. Major Beazeley was not hit; and the R. A. F. pilot, though mortally wounded, contrived to bring down the machine safely, but within the enemy's lines He died shortly afterwards and Major Beazeley was promptly sent by air to Mosul by the Turks, with whom he remained a prisoner until the Armistice. The loss of the gallant pilot was greatly to be deplored, while the capture of Major Beazeley, well known for his energy and ceaseless activity in the advanced areas, was most unfortunate.

Camera Stabilizer.

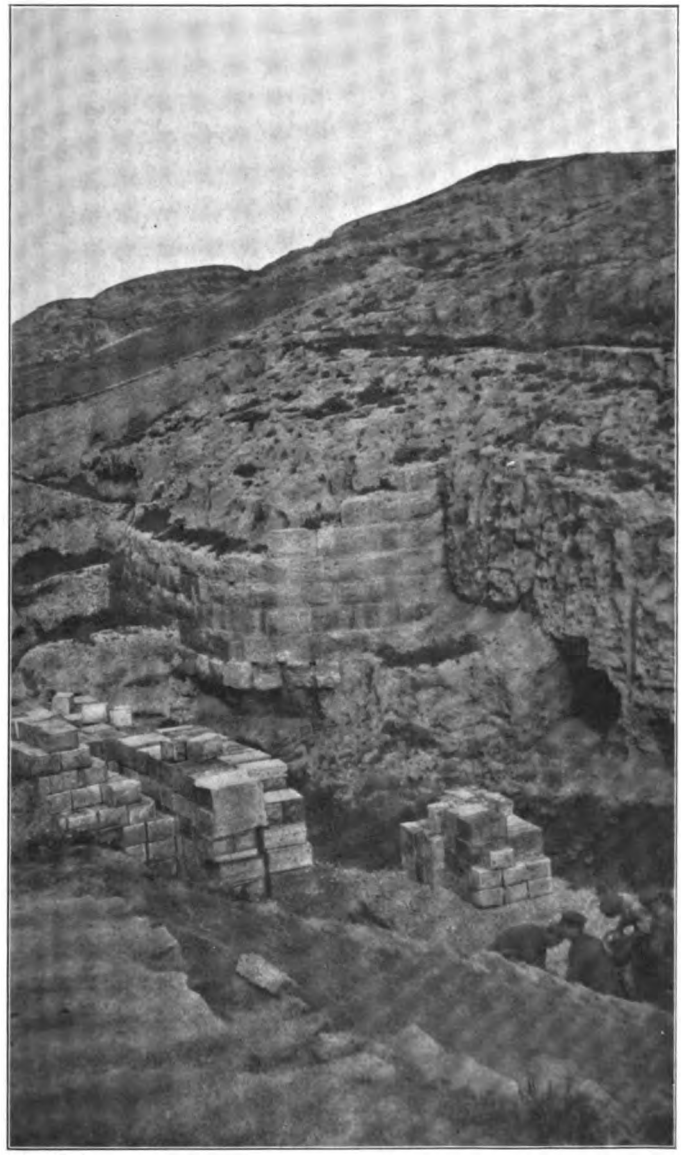
About this time, the R. A. F. asked the survey authorities in Baghdad to design some form of stabilizer for their aeroplane cameras. Captain de Graaff Hunter undertook this problem. The camera was mounted on gymbals, and change of centre of gravity as the positions of successive plates varied was automatically compensated. The necessary drawings were completed on the 30th May.

After the supression of the Najaf conspiracy, which had led to the murder of Captain Marshall in March, there was no other trouble with the tribes, on either the Tigris or the Euphrates L. of C., during the summer of 1918, and the relations with the Bakhtiari Khans in the oilfields in Arabistān were satisfactory. Surveys therefore were continued uninterruptedly wherever required.

Continuation of surveys on the Euphrates.

At the end of April, Lieuts. Booth and Pollet finished their work on the Euphrates front in the Khān Bhagdādi—Sahilīyah—Hīt area. Subadar Puri continued to supervise surveys between Sahilīyah and Hīt, accomplishing his work successfully in spite of the extreme heat. Lower down, Lieut. Fielding extended his former work from Musaiyib and Hillah southwards to Kifl and Kufah during the summer, and completed a large area with a creditable lack of friction with the inhabitants. Captain de Graaff Hunter, having finished his Tigris-Euphrates junctions, mentioned in the last chapter, commenced a further connection down the Shatt-al-Hai towards Hai town on the 1st May. He was, however, recalled a week later to replace Major Beazeley with the 3rd Corps. On completion of his triangulation south of Najaf and Kufah early in May, Lieut. Kitchen replaced Captain de Graaff Hunter on the Shatt-al-Hai and worked from Qalat Sikar southwards towards Shattrah-al-Muntafik in the direction of Nāsirīyah. This was an area where the attitude of the tribesmen was always uncertain. He worked with tribal escorts and transport far from any military posts. His knowlege of Arabic and his tact in dealing with

PLATE 6.



A BASTION OF THE WALL OF ANCIENT ASSHUR (SHARQAT).

[to face page 34]

the inhabitants enabled him to work steadily throughout the summer and autumn.

With the advent of cooler weather, Lieut. B.C. Newland, who joined the Directorate in September, started a series northwards from Nāsīrīyah to meet Lieut Kitchen's work. The junction was effected in December.

Survey reaches the Fat-hah gorge.

Early in September Major L.C. Thuillier with two surveyors joined the 17th Division at Tikrit. The whole area between this point and the Turkish position at the Fat-hah gorge was surveyed during this and the succeeding month. About the middle of October, Lieut. A.F. Murphy, who had joined the Directorate in August, and Lieut. Booth arrived with more surveyors, and Major Thuillier then was able to take up ranging work for the gunners. During the same period Lieut. Pollet was surveying with the 3rd Corps on the Kirkuk front.

Battle of Sharqat and occupation of Mosul.

In October General Cobbe received orders to advance on Mosul. The subsequent operations led to a complete stampede of the enemy; the whole Turkish army was enveloped north of Sharqat, the ancient Asshur, and with its commander, Ismail Haqqi, surrendered on the 30th of that month. An advance was immediately made towards Mosul, but the Armistice with Turkey was concluded before that place was reached. The terms, however, included the evacuation of the town by the Turks, and it was occupied on the 3rd November 1918.

The Armistice.

The final victory once more opened up vast possibilities for further surveys. The country was, for the moment at any rate, at peace. But the advance had been so rapid that junctions had not yet been made by triangulation from existing work to Mosul and Kirkuk. It was essential also to connect these places with each other, and to survey the intervening areas. By the terms of the Armistice too, the Turks were ordered to evacuate Central and Southern Kurdistān, and it was most desirable that surveys and reconnaissances should be pushed as far as practicable into the heart of these almost unknown regions, if the British were to maintain order amongst the predatory tribes who dwelt there.

Furthermore, the successes in Palestine had led to a great extension of the operations of the Survey of Egypt, and it became most desirable to effect a connection with them, and to extend the Mesopotamian surveys and reconnaissances towards Syria.

Surveys in Mosul area.

Major Thuillier was present during the attack on the Fat-hah position, and subsequent victory at Sharqat. Then, leaving Lieuts. Booth and Murphy to continue the triangulation and survey in the wake of the pursuit, he joined General Fanshawe's column. On arrival at Mosul on 5th November, a new base was measured, triangulation was commenced and the survey of the neighbourhood was put in hand on the arrival of the surveyors before the close of the month. By the end of the year the new work in the Mosul vicinity was connected to that of Lieuts. Booth and Murphy, and also to that of Captain de Graaff Hunter from Kirkuk. The survey was then extended in all directions from Mosul, and Major Thuillier commenced an air survey of the town itself. On

the 27th January, on his recall to India, to assume charge of a Survey Circle, he handed over the command of the Mosul section to Lieut. Booth.

The latter now devoted his energies to the area north of Mosul, completing 4500 square miles of ½-inch survey here, besides finishing 500 square miles to the south, before 30th April.

Lieut. Murphy of the same section triangulated between Fat-hah and Sharqat, and thence to the ruins of Hatra, thirty miles to the west, returning to Mosul by the desert route; later he triangulated to the Jabal Sinjar, sixty-five miles west of Mosul. The surveyors with him executed ½-inch surveys, and 1-inch surveys were made between Fat-hah and Mosul, and of the area within a radius of 10 miles from the city. Early in March, Lieut. Murphy began the triangulation and survey between the Tigris near Mosul and the Greater Zāb rivers up to latitude 37°. The country was generally hilly with three long ranges from 1500 to 7000 ft. in elevation, thinly covered with oak. The razor-like ridges with rocky cliffs 300 ft. high just below the crests, were conspicuous features of the country. Only sufficient triangulation was done to control the detail survey, but it was greatly hampered by rain and fog which rarely cleared before noon. The rate of detail survey varied much according to the ground and local tribal conditions, being from 160 square miles per man per month along the Greater Zāb and near Aqra, where the ground was rugged and difficult, to 250 square miles near the Tigris and Zākho, where the ground was less steep and less intricate. The transport used in the higher hills consisted of local mules, donkeys and cattle, and, on the lower ground, of camels. These and the gendarmerie escorts were supplied by the local political officers. This work was completed rapidly and efficiently by the 25th May when the survey section was withdrawn.

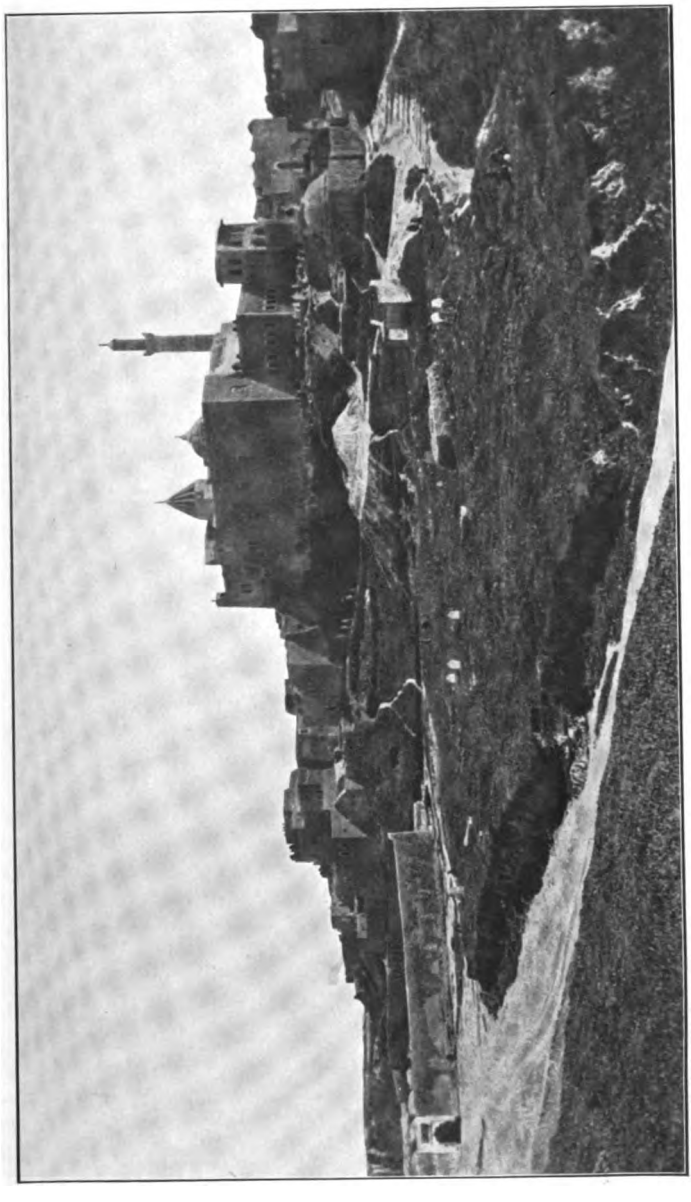
Surveys in Southern Kurdistān and Kirkuk area.

Captain de Graaff Hunter had joined Lewin's column at Kirkuk on 10th November 1918. He triangulated a large tract of country in Kurdistān towards the Persian boundary beyond Sulaimāni and northwards to the Lesser Zāb. Later he took up the area west of Kirkuk to Fat-hah; he also reconnoitred several routes between these places, thereby shortening the L. of C. to Kirkuk, which hitherto had been via Altūn Kūpri. Lieut. Pollet worked near Altūn Kūpri at first and then moved to Arbil, whence he was able to deal with the areas stretching westwards to the Tigris and to Guwair on the Greater Zāb.

Precise Levelling.

After the occupation of Baghdad, an Irrigation Directorate had been established. The various maps and plans prepared before the war by Sir William Willcocks were examined, and immediate arrangements were made to repair existing works and canals which it appeared profitable to put in working order. It was found that, although a great deal of levelling had been done by Willcocks, most of the benchmarks either had been destroyed, or could not be located. At any rate, there were not enough sufficiently reliable marks for new irrigation projects. During the summer of 1917, the question had been referred to the Surveyor General of India; but the latter was not then in a position to send a levelling detachment to Mesopotamia. The matter was therefore dropped.

PLATE 7.



NABI YUNIS: THE RUINS OF NINEVEH.

[to face page 36]

The Inspector General of Irrigation in India, who visited Mesopotamia during the spring of 1918, agreed that accurate levelling was absolutely necessary. Colonel Lenox-Conyngham, R.E., F.R.S., Superintendent of the Trigonometrical Survey of India, therefore visited Mesopotamia to investigate the exact conditions as regards precise levelling. The result of this visit was that two levelling detachments were sent out, arriving at Basrah on 4th October 1918. The Tigris detachment under Lieut. D.H. Luxa, and the Euphrates detachment under Lieut. J. McCraken, both carried out their work with great rapidity and accuracy. The results were of much use to the Irrigation Directorate and other departments in Mesopotamia. The total outturn was, including branch lines, 956 miles of "simultaneous double levelling", in the course of which the heights of 26 primary (standard), 406 secondary and 467 tertiary bench marks were determined. The results were published in a levelling pamphlet printed at Dehra Dūn.

Strength of Directorate.

During 1917 and 1918, the survey responsibilities in Mesopotamia had very much increased, and on the 1st May 1918, the total strength was as follows:—

Four officers of the Imperial Service, 7 of the Provincial Service, 44 Indian officers and surveyors of the Upper and Lower Subordinate Services, as well as an adequate staff of men engaged in map drawing and reproduction at Baghdad.

Map Compilation Section joins the Directorate.

On the 1st September 1918, Lieut.-Colonel C. P. Gunter, and the Map Compilation Section, which had hitherto been a separate unit throughout, were put under the direct control of the Deputy Director of Surveys. The strength of the Survey Directorate now consisted of 8 officers of the Imperial, 15 of the Provincial Service, 40 Indian officers and surveyors, and 39 draftsmen and others engaged in map reproduction.

The headquarters of the Survey Directorate were now moved to a new office next to the Map Compilation Section. Mr. Oddy, from the Trigonometrical Survey Dehra Dūn, was attached to the Directorate, and gave much advice in the organization of the helio section. After the Map Compilation Section had been disbanded, the drawing office was reorganized and put in charge of Major L.C. Crosthwait, who had under his orders eight Indian draftsmen. These now took up the fair drawing of the ½-inch maps of Mesopotamia and Persia for reproduction in colours.

On his appointment as Surveyor General of India, Colonel Ryder handed over the Directorate to Lieut.-Colonel Gunter on the 15th February 1919.

Approval in Despatches.

In his despatch dealing with the operations of the force during the period from the 1st April to 30th September 1918, Lieut.-General Sir William Marshall wrote:

"Surveys and the Map Compilation Section have always risen to the occasion, and have continued to produce a large output of admirable work".

CHAPTER VI

KURDISTĀN AND THE SYRIAN DESERT

General.

IN the last chapter mention has been made of the Armistice terms, which required the Turks to evacuate certain parts of Kurdistān and the Euphrates. It was not possible in the time nor with the staff available to extend regular surveys throughout all these areas, and recourse was had to reconnaissance and rapid surveys. It is proposed in this chapter to deal with four of these, two in Kurdistān, and two far up the Euphrates. Of these four, the most accurate and therefore the most valuable was Captain Lewis' connection between the triangulation of Mesopotamia and that of Palestine at Aleppo. But the rapid reconnaissances in Kurdistān were also to prove useful in the rebellion which took place so soon after. These latter were undertaken, under the auspices of the General Staff and the Political authorities, by Major Mason, R.E., and Khan Bahadur Sher Jang.

1. *Central Kurdistān.*

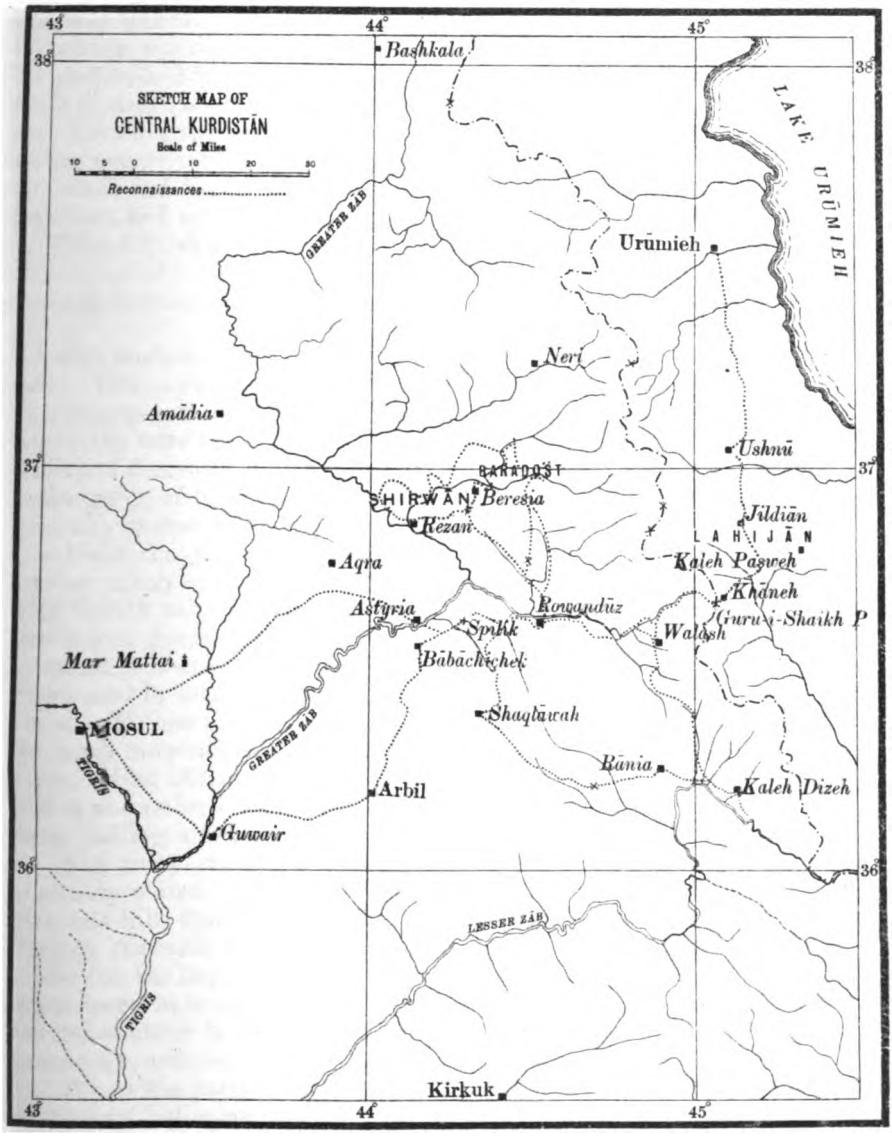
Reconnaissance plans.

In agreeing to evacuate Central Kurdistān, Ali Ihsan Pasha, the Turkish Commander-in-Chief at Mosul, asked rather maliciously whether the British were prepared to police that area. The G. O. C. in Mesopotamia demanded a list of posts and prepared to take them over. Major Mason, who had reverted from the Survey of India to military duty, was ordered to proceed to Rowandūz, and carry out a reconnaissance. His party consisted of Captain S. Murray, R.A.M.C., and two men, Sergt. Burgess and Corpl. Smith, 13th Hussars. No regular survey personnel could be included owing to the utter destitution of the region, but it was hoped that a fairly accurate ¼-inch map would be made.

Area visited.

The country visited lay mainly south of the depopulated Nestorian and Jilu belts, west of the Turco-Persian frontier and north-west of the Sulaimāni district. This area had suffered frightfully during the war. The Russians had been the first to move, one force based on Hamadān operating towards Khāniqin, while another advanced from Lake Urūmieh towards Rowandūz. In August 1916, on the capture of the latter place, some six thousand of the population were massacred by the Armenian troops with the Russian forces. At first the Kurds had sided with their "deliverers", but friction soon followed the harsh methods of Russian control, and the tribes harassed the L. of C. When the Russians subsequently evacuated the district, for their own safety they took the precaution of wiping out almost every village on their line of retreat. The

MAP VI



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Kurds had then reverted to Turkish control, but by this time the commissariat was so dependent on the country that the population died of starvation in hundreds. Epidemics of typhus and influenza increased the toll of lives, but the diseases were subsiding at the time the Armistice was signed. In the beginning of 1919, the country north of Rowandūz was desolate. In certain districts, there were neither villages nor people, and in the words of a political officer, "There seemed to be a smell of death about the whole country".

The only towns of importance in the area were Rowandūz and Neri. At the end of the war, the former had only sixty houses left out of two thousand, and Neri something under ten. The whole country had in fact been laid waste by fire, sword, disease, pestilence and starvation.

Journey to Rowandūz.

The British party left Mosul on 2nd January 1919, and had some difficulty in fording the Greater Zāb at Astyrīa. The transport, returning a few days later after a severe storm in the hills, lost two ponies and one Kurdish muleteer drowned while crossing the swollen river at the same spot. The so-called cart-road via Bābāchichek to Rowandūz was struck 4½ miles east of the Zāb river, and the limestone mountains of Central Kurdistān were reached by the zig-zag ascent to the Spīlik pass. The road then descended a side valley to the Khalīfān stream at the entrance to the gorge of Gali Ali Beg. The Kurds met with were all armed, and generally greeted the party's arrival by firing off their guns and rifles.

Near the junction of the Khalīfān and Rowandūz rivers the road became much rougher. The steep slopes of the hills were well wooded with dwarf oak, sycamore and scrub. Where the road entered the Rowandūz gorge, the latter was hardly ten yards wide. The road appeared a mere scratch six feet wide along the southern cliffs of the gorge, and in many places was nearly a thousand feet above the torrent below. It then turned up the Bekhāl defile, and crossed the stream by the usual ramshackle Kurdish bridges three times in about two hundred yards. Just above the last of these, the torrent issued from the gorge wall in a number of springs, forming one large unfordable volume of water falling into the defile from a height of seventy feet.

The party reached Rowandūz on 7th January and found it in ruins as already stated. Major Noel, a political officer, had recently arrived over the hills from Sulaimāni and assumed the administration from the Turkish *Kaimakam* who had been sent off to Mosul. There was no fodder for the baggage animals and they too were sent back. Arrangements were now made to get barley for the riding ponies from Arbil, but the weather broke and the Turkish military road to the latter place became impassable.

While the party was delayed at Rowandūz, Captain Murray spent his time in relieving distress. Of the six hundred people in the town, half were unable to stand and were in various stages of starvation. The small stock of supplies and medical comforts brought up by the detachment for its own use was soon exhausted, but the results achieved were remarkable.

The British party of five then arranged to ride through the country. The Kurd is excessively lazy when not engaged in plunder, and it was

found very difficult to make early starts. There were endless delays both before and during the march, and it was seldom that the party reached its destination during daylight, which was very unfortunate for the proposed map. On arrival at a village the British party was generally taken to the chief's guest room, a fire was lighted and tea was made. The chieftains of most of these tribes lived in the main fort of the village, surrounded by a high wall, two or three feet thick, built of solid masonry and with only one entrance by a heavy door securely barred at night. No windows were accessible from the ground and those of the upper storeys were generally made primarily for loopholes. A circular loopholed bastion usually stood at each corner of the fort. Within the walls was a courtyard, and the rooms, generally in two storeys, sometimes in three, faced inwards to the court. The party took its meals with the Kurds round the fire on the floor of the room, every one dipping into the same bowl.

The reconnaissance beyond Rowandūz.

As an example of the destitution in some of the parts traversed, it may be mentioned that during one particular fortnight, the party subsisted on *chapattis* made from acorns fallen from the wild oak, once in this period getting a little wild honey, and once some sour curds.

Major Mason made a sketch map of the country on the ¼-inch scale, showing the hill features by form lines at approximately 250 feet interval. His method of work was to accept at first the positions of certain places, such as Rowandūz, until he arrived near the Persian frontier, when the Turco-Persian Boundary Commission's fixed points were observed by compass. The work was checked on as many points as possible, and closed on triangulated points on the southern ranges fixed by the Survey of India triangulators under Captain de Graaff Hunter, who was working at the same time in the foothills. The area reconnoitred and sketched in Central Kurdistān amounted to 2400 square miles.

Sketch map.

The country consists of parallel valley troughs, drained by affluents of the Zābs. The easiest lines of travel are almost always in a northwest and southeast direction, except near the Greater Zāb, where deep gorges are the rule and diversions have to be sought. Neither carts nor roads in the European sense exist in the country, but the Turkish so-called military cart road already mentioned is continued from Rowandūz over the Guru-i-Shaikh pass on the frontier to Ushnū and Urūmieh.

Physical features.

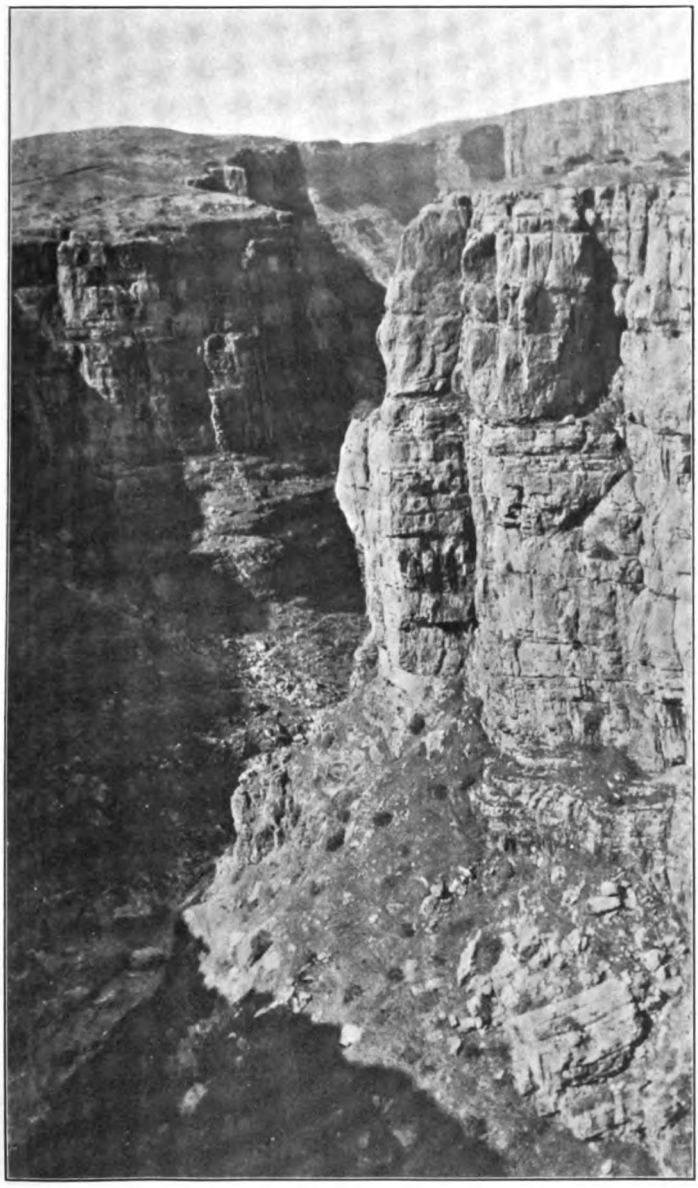
The climate is one of extremes but quite bearable. The normal winter snowline appears to be about 3500 feet, January, February and March being the months of greatest snowfall. The spring is mild, but travel is much impeded by snow passes and flooded rivers. In summer it is very hot and close in the valleys, but higher up on the northward facing slopes probably quite pleasant.

Climate.

2. *Central Kurdistān and Urūmieh.*

Khan Bahadur Sher Jang of the Survey of India had been attached

PLATE 8.



THE RIVER GORGE NEAR ROWANDŪZ, CENTRAL KURDISTĀN.
THE SITE OF THE MASSACRE OF KURDS BY RUSSIANS, AUG. 1916.

[to face page 40]

to the Turco-Persian Boundary Commission at the outbreak of war. He had then made friends with many of the leading Kurdish chieftains and notables along this long frontier.

Sher Jang attached to Political Department.

Towards the close of 1918, Colonel A.T. Wilson, Civil Commissioner, proposed to Colonel Ryder, then D.D. Surveys at Baghdad, both of whom had been on the same Commission, that Sher Jang should be despatched on a political mission through Central Kurdistān. Colonel Ryder agreed to the proposal, at the same time pointing out that this would afford an opportunity for extending reconnaissances into these little known districts.

Sher Jang was accordingly temporarily transferred to the Political Department and reached Mosul early in January 1919. Leaving this town with four survey khalasis on 25th January he travelled by Arbil and reached Rowandūz on 1st February. Two days later he continued his journey to the Shirwān country, meeting Majors Noel and Mason at Beresia engaged on the work described above. The weather throughout this period was bad owing to heavy snowfalls and the route traverse was only carried on with difficulty. After accompanying Major Noel along the gorges of the Greater Zāb, he returned by Chinara and the Baradost country to Rowandūz.

The Shirwān Country.

At this time, the tribes of Central Kurdistān were on the whole friendly and their chieftains were seeking the protection of the British. As already mentioned, they were in an appalling condition of destitution and were glad of an order of affairs which led to stability. On the outskirts of the area nominally under British control, however, Turkish influences were undermining British prestige. In the north, Sayyid Taha, who was regarded with the highest veneration throughout Central Kurdistān, and who was in a position to control the whole country between Bashkala, Rowandūz, Ushnū and Urūmieh, was being affected by the subtle blandishments of the Turks. He had been invited to meet Major Noel, in order that the situation might be discussed, but so far he had remained aloof.

Political factors.

Early in March, Sher Jang received orders from Baghdad to go to Urūmieh, to meet Sayyid Taha and to endeavour to negotiate with him. He left Rowandūz on the 9th with his four Indian khalasis, two gendarmes and a few mules, and took the main route into Persia by way of which the Russians had advanced and retired. Along the way villages were lying burnt and desolate. At Walāsh, he learned that the Guru-i-Shaikh pass on the frontier was blocked with snow, and he was forced to abandon his bedding and mules. Two khalasis also remained behind, but with the two others and a local guide he crossed the pass on the 15th. Of the district on the Persian side of the frontier Sher Jang relates:—

Sher Jang ordered to Urūmieh.

"The scene was dreadful. In July 1914, when the Commission was here, four hundred mounted men of the Pirān greeted us. The population was dense and the country beautiful. Today it is desolate. In the

Condition of Lahijān.

evening I reached the deserted ruins of Khānah. There was not a single house left standing, so we passed the night under cover of the mountain. The whole ground was under snow. There was no fuel, for throughout Lahijān all wood had been commandeered, even the timbers out of the houses. We had no bedding, so huddled together for warmth. We could not sleep owing to the intense cold; and if for a moment one of us should doze, the guide would wake him up, saying that the Lahijānis were so destitute and famished that they ate men for food .....".

From here onwards the country had become a desert. At Jildiān, there were only two houses left out of three hundred. Ushnū was even worse. To quote again from Sher Jang's account:—"The ruins are horrible", he writes. "Before the war there were fifteen hundred houses; during it the people were slaughtered and the houses burnt. Fifty houses now are sparsely inhabited. In a lane I saw a few emaciated men and women sleeping in the sun. Their faces were dreadful, and they looked like savages. I stayed the night with Hamza Agha, chief of the Zarza tribe. On 1st August 1914, I had been a guest of this Sardar in this once beautiful city. His house was then richly furnished; he lived like a prince... Today he is a beggar. In 1914 the population of Ushnū was 24000, I asked what had become of them.

" 'Ten days ago', the Agha replied, 'there were three thousand; twenty thousand are dead. In a few days there will be only two thousand, for there is practically nothing to eat'. "

Arrival at Urūmieh.

On the 20th March, Sher Jang reached Urūmieh. About six miles from the city he was met by a hundred armed horsemen, who at first appeared hostile. As they approached, however, a gigantic Kurdish Sardar recognized Sher Jang, who was at the moment counting his paces for his route survey. The Sardar came forward and Sher Jang was relieved to find he was Qarni Agha, the host of the Boundary Commission at Kala Paswah in Lahijān, in 1914.

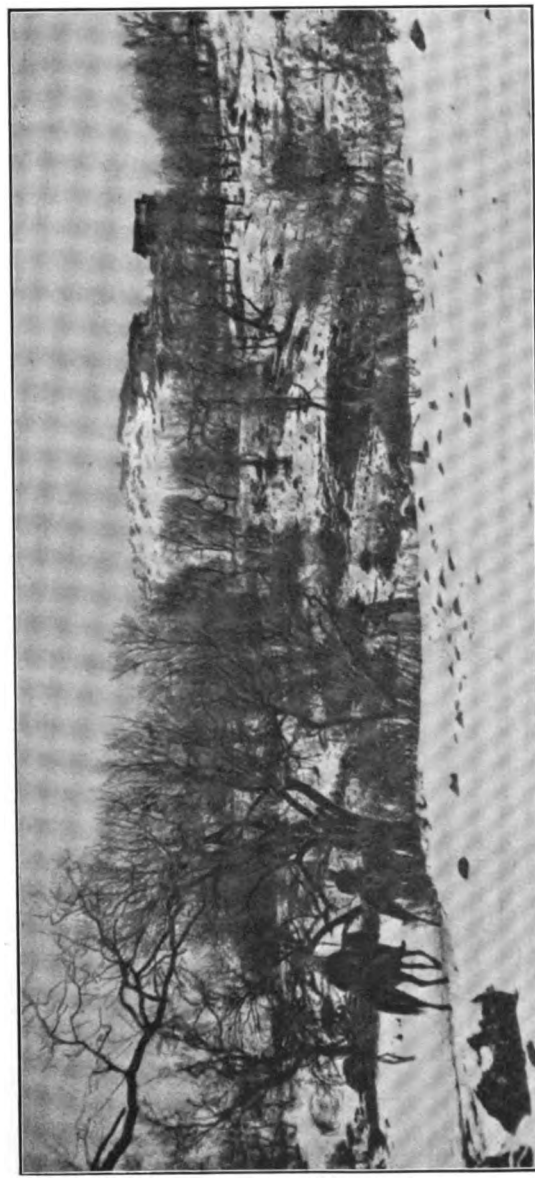
The meeting was a lucky one for Sher Jang, for he now learned that the Persian governor had received from spies news of his approach, and intended to have him murdered. The blame for this treachery would be laid to the Kurds' account whose "faces would then be blackened in the eyes of the British". Qarni Agha, a Sunni, hated the Shiah governor, so the plan miscarried.

Sher Jang immediately sought out the Persian governor, who was all smiles. But he refused the offered hospitality, explaining that he was well-known in Urūmieh and the friend of the warlike Kurds outside the town.

Sayyid Taha, whom Sher Jang had come to visit, was unfortunately some six stages away at Chahari, and Sher Jang dared not leave Urūmieh owing to the hostility of the governor. He therefore despatched a letter asking the Sayyid to visit him in Urūmieh. Meanwhile Kurds of various tribes offered him their protection, amongst whom were the warlike Herki.

During his stay at Urūmieh Sher Jang received a letter from Jodat Khānum and Asura Khānum, asking if they might visit him. He

PLATE 9.



NEAR KANI-RASH, BARADOST COUNTRY.

[to face page 42]

was much impressed by the devoted courage of these two Nestorian ladies, both of whom had been educated in America. After the defeat and flight of the Nestorians, they had voluntarily remained behind to look after the old women and sick children who were unfit for the perils of the robber-infested roads. Here in Urūmieh, the community of some 800 persons lived in constant fear of a Kurdish rising, which would mean death to all of them*.

The Nestorians.

Sher Jang describes the condition of Urūmieh as ghastly. Whole streets were demolished and desolate and gave out the horrible stench of unburied corpses. The poorer classes, who still lived, lay starving and dying by the wayside, too weak to rise. The city had suffered from the tyranny of Russia, the persecution of Turkey and the brutality of Persia. The unhappy inhabitants never knew with whom to side, for the fortune of war changed too rapidly. The Turks had slaughtered all oxen for food, with the result that the fields could not be cultivated. People of one sect massacred that of another; the hand of Kurd and Persian alike was lifted against the richer Christian. When the Russians finally left the place, they sold their weapons to the Nestorians. These turned on the Musalmans in revenge. All parties were now armed, and fighting, massacres, looting and burning reduced the countryside to a wilderness.

Condition of Urūmieh.

Sayyid Taha, on receiving Sher Jang's message, collected a hundred horsemen and rode into Urūmieh, which he reached on the 25th March. The two had last met on 30th October 1914. Throughout the following night the situation was discussed. Sher Jang learned that Shaikh Mahmud of Sulaimāni had proposed a *jahad*, and that the notables of Kurdistān had called a meeting to discuss the prospect. They had at this meeting proposed to rise in the Urūmieh district against the Persians and turn them out. Sher Jang urged the case against further barbarities, and at last, as dawn was breaking, persuaded Sayyid Taha to accompany him to Rowandūz.

Sayyid Taha.

On the 10th April the party left Urūmieh, the Sayyid taking as escort a number of Herki and Shikak horsemen with him. Travelling rapidly through the desolate country, they reached Rowandūz on the 15th. Sher Jang's difficult political mission had been successfully accomplished, and it is no exaggeration to say that his success had a large share in maintaining tranquility in the Rowandūz district during the subsequent rising in Southern Kurdistān. The actual survey work done in connection with the journey, as can be imagined, could only be of the reconnaissance class. As such it was valuable, for it extended into areas the maps of which were very inaccurate. He filled in certain blanks adjoining the areas covered by Major Mason and extended the work of the latter from Walāsh over the border to the ruins of Khānah. Beyond this point, the weather was so bad and the desolate marches were neces-

Sher Jang returns to Rowandūz.

* A massacre of Christians by Kurds took place in May, and it is feared that most of these women and children were butchered in cold blood.

sarily so long, that it was not possible to climb commanding points from which good views could be obtained. A route sketch was however carried out, and this, in conjunction with the Russian maps that Sher Jang obtained in Urūmieh, proved most valuable.

3. *Hadīthah-Aleppo Survey.*

Euphrates valley Detachment.

After the Armistice with Turkey, a detachment was formed under Captain C. G. Lewis, R.E., to survey the valley of the Euphrates upstream of Hadīthah. The detachment included Jemadars Iltifat Husain and Nur Ahmad, 3 interpreters, and 15 khalasis. At Hadīthah, which was reached on the 19th December 1918, work was commenced in continuation of that done by Lieut. Pollet earlier in the year. Triangulation was carried up both banks of the Euphrates to Ānah in advance of the surveyors, who were employed during December, January and February on the 1-inch detail survey. By the beginning of March the latter was completed up to longitude 41° 55′, a few miles west of Ānah. Here the country became more open and the work was continued on the ½-inch scale to Salahīyah, twenty miles upstream of Albu Kamal, at which place the work closed on the 9th April 1919.

Triangulation reaches Dair-az-Zōr.

Meanwhile Captain Lewis had carried his triangulation up the river to Dair-az-Zōr. The original programme was to complete the survey to this point, Captain Lewis as well as the surveyors being employed on detail surveys after the completion of the triangulation. On arrival at Dair-az-Zōr, however, on the 20th February, Captain Lewis received instructions from Colonel Gunter to continue the triangulation as far as Aleppo, to connect there with the Egyptian work, and at the same time to complete as much detail survey as possible on the way.

Aleppo.

Captain Lewis therefore left Dair-az-Zōr on the 4th March, triangulating and sketching the topography on his chart on the ¼-inch scale up the Euphrates valley to Meshkeneh. From here he left the river to cross the desert to Aleppo, reaching that place on the 20th March. The field work, including sufficient computations to control the planetabling, was thus completed in sixteen days over a distance of two hundred miles, a very fine performance.

Details of triangulation.

Bases were measured at each of the following places:—Hadīthah, Albu Kamal, Dair-az-Zōr and Aleppo; azimuth observations were included at six stations. The triangulation started from Lieut. Pollet's "Hadīthah S.", and well conditioned triangles were obtained generally with stations on both sides of the Euphrates, all angles being observed. *Shaktūrs*, or local river boats, were obtainable for transport from Hadīthah to Ānah. From here camels were used along the right bank; it was no longer possible to cross the river and the series was extended almost entirely by means of "pivot points" fixed by intersection on the opposite bank.

Throughout the whole valley of the Middle Euphrates, cairns had

PLATE 10.

NEAR BERESIA, SHIRWĀN COUNTRY.

[to face page 44]

January this mist no longer formed, but from a short time after sunrise until nearly sunset the mirage was always bad except on very dull cloudy days.

Capt. Lewis at Aleppo.

At Aleppo, the O.C. No. 7 Field Survey Company, R.E., of the Egyptian Expeditionary Force, with two other officers of the company, met Captain Lewis in order to arrange for a connection to be made with the local triangulation, when this should reach Aleppo. An astronomical latitude and a value of longitude by wireless time signals from Paris and Berlin had already been obtained at Aleppo by the E.E.F. Survey Company, but the exact position of the observation point among buildings near the railway station was unfortunately unknown owing to the absence of the officer who had carried out the observations.

Junction with Egyptian triangulation.

Captain Lewis resected the approximate position of the point on his planetable, and the values of latitude and longitude were read off therefrom. As the scale was $\frac{1}{4}$-inch, on which one second of arc is represented by $\frac{1}{113}$ of an inch along the meridian, and $\frac{1}{258}$ of an inch along a parallel, it was not possible to read closer than 2 or 3 seconds; and to this accuracy agreement seemed perfect. Three of Captain Lewis' stations were subsequently fixed by E.E.F. triangulation and their coordinates were then computed. A comparative statement of the values obtained is given in the following table:—

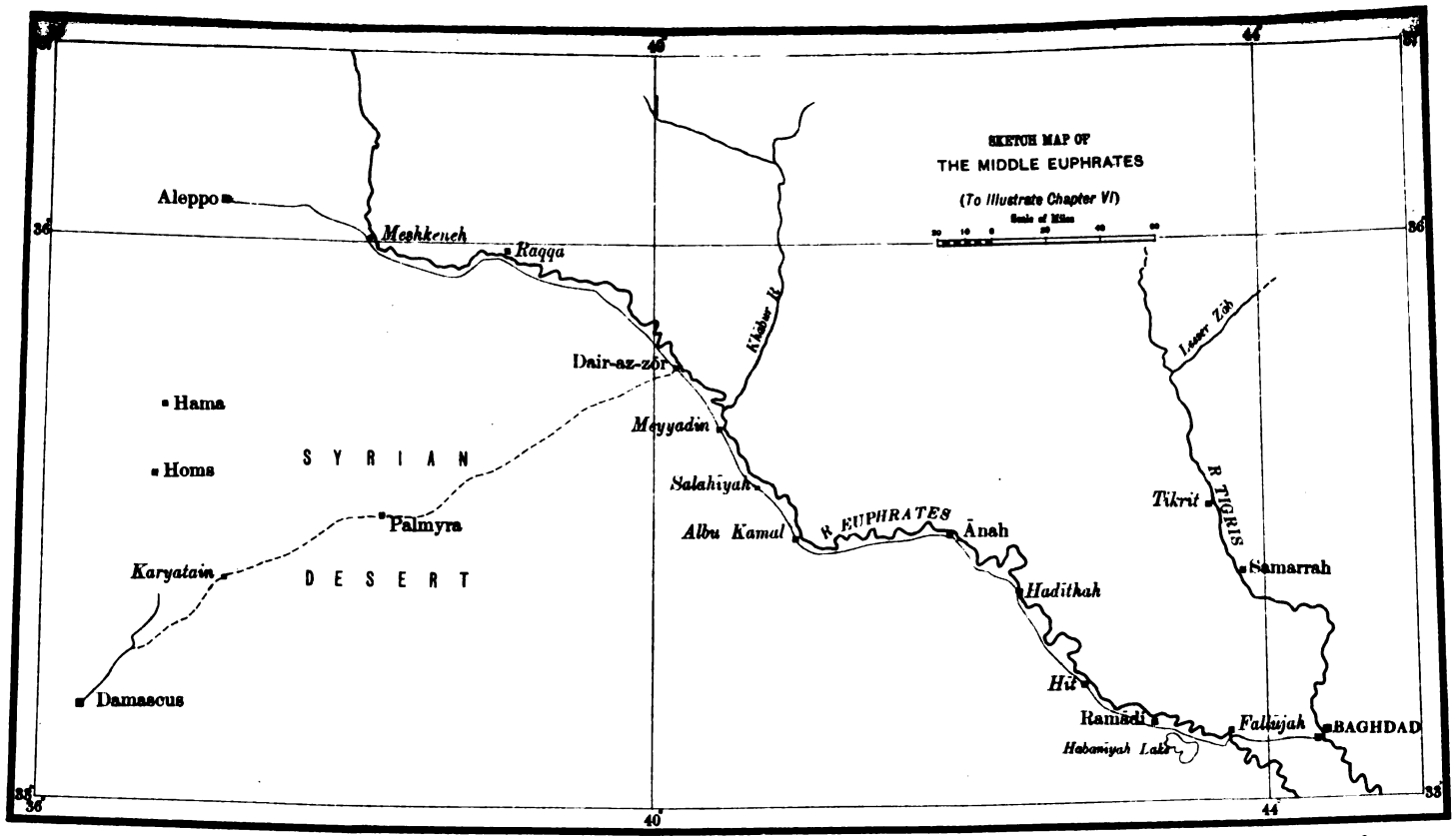
Closing differences at Aleppo between M.E.F. triangulation from Fão (Persian Gulf) and E.E.F. triangulation from Qantāra, (Suez Canal).

Name of station	E.E.F. revised * values in Qantāra terms = E.	M. E. F. values in Fão terms = M.	Difference = M − E.
LS 82	Lat. 36° 12′ 04″·50 Long. 37° 17′ 51″·80 Height 1541 feet	Lat. 36° 12′ 12″·74 Long. 37° 17′ 50″·50 Height 1573 feet	+ 8″·24 − 1″·30 + 32 feet
LS 84	Lat. 36° 11′ 58″·40 Long. 37° 11′ 14″·00 Height 1410 feet	Lat. 36° 12′ 06″·08 Long. 37° 11′ 12″·76 Height 1436 feet	+ 7″·68 − 1″·24 + 26 feet
LS 85	Lat. 36° 6′ 57″·30 Long. 37° 13′ 29″·80 Height 1702 feet	Lat. 36° 07′ 05″·23 Long. 37° 13′ 29″·09 Height 1734 feet	+ 7″·93 − 0″·71 + 32 feet

Mean differences M − E	Latitude	+ 7″·95
	Longitude	+ 1″·08
	Height	+ 30 feet

* These values were sent by the Survey of Egypt (Mudiria) in their No. 1/51 (Triangulation) of 5th August 1919.

MAP VII



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The discrepancies are extremely small, especially when it is considered that the starting points of the two triangulations—Qantāra and Fāo—were fixed independently by astronomical latitude and longitude observations. It is also to be remarked that Captain Lewis' work was computed on the Everest spheroid, as was all the triangulation of the M.E.F. and that changes of the order of 5″ would result from a change to the Helmert spheroid, upon which the Egyptian Expeditionary force work was based.

The junction thus effected between Basrah and Cairo by continuous triangulation would ordinarily be classified as tertiary. The standard of accuracy attained is much superior to this class and is extremely creditable to all parties concerned.

The following details of the triangulation are of interest:—

Total length of series.	400 miles.
Number of stations observed at, including base stations.	114
Intersected points.	173
Bases measured.	4
Azimuths observed.	6
Average triangular error (65 triangles)	10″
Average difference between common sides in feet per mile in station triangles.	0·5
Do. Do. in triangles with intersected points.	1·3
Number of triangles computed for stations.	270
Number of days work.	57

It would be misleading to give the average length of sides of triangles as they varied between such wide extremes. The shortest side was one mile, and the largest over 20 miles.

A steel tape was used for base measurements. The differences between the two measures of the bases, which ranged from 3500 feet to 5000 feet, were as follows:—

Hadithah.	0·65*	feet.
Albu Kamal.	0·05	„
Dair-az-Zōr.	0·05	„
Aleppo.	0·01	„

At each of the six azimuth stations, simultaneous observations of horizontal and vertical angles to east and west stars were made, one or more pairs of stars being used at each station.

* This big difference was probably due to the tape stretching during the first measurement, the second being the smaller value. This was the first time the tape had been used.

Results of azimuth observations.

Name of Station.	Difference between observed azimuth and azimuth computed from the triangulation (correction to triangulated azimuth).	Length of triangulation from previous observed azimuth in miles.	Remarks.
Hadīthah.			Base measured: Azimuth observed.
Anah. L. S. 18.	−18″	45	Azimuth observed.
Albu Kamal. (New Base).	−31″	70	Base measured: Azimuth observed.
Dair-az-Zōr. L. S. 52.	+34″	85	Base measured: Azimuth observed.
Aid. L. S. 70.	−57″*	110	Azimuth observed.
Aleppo. L. S. 84.	−36″	90	Base measured: Azimuth observed.

Return of Detachment.

Captain Lewis left Aleppo on the 31st March and arrived at Albu Kamal on the 4th April. During this time the two surveyors had carried the ½-inch detail survey to Khān Šalahīyah, and joined up with the sketch survey. Work then closed and Captain Lewis and the surveyors returned to Baghdad.

This work is an excellent example of how triangulation and surveys can be carried out with great rapidity, and of how the work can be scientifically controlled at the same time with full consideration of the local conditions. The greatest credit is due to Captain Lewis for these very satisfactory results.

4. *The desert route from Baghdad to Damascus, via Palmyra.*

Proposal and Personnel.

During the war several reports were received by the Intelligence Branch, M.E.F., that the Germans and Turks had been opening up the desert route from Damascus to Dair-az-Zōr. On his return from Kurdistān, Major Mason made proposals for a reconnaissance of this route to investigate these reports. Sanction was obtained in March 1919 for the

* Much of this error probably occurred in the very short side between L. S. 65 and L. S. 66.

PLATE 11.

THE DESERT GATE, SALAHIYAH.

[to face page 48]

journey to be undertaken in one Ford car, with six Ford vans to carry petrol, water and spares. Baggage was cut down to a minimum and included one light roll of bedding per man.

The party consisted of Major Mason in charge, Captain S. Murray, R.A.M.C., Captain Carver, Political officer, Sergt. Griffiths, R.A.S.C., one motor mechanic and seven drivers. Major-General L. Jones, Commanding the Cavalry Divison, and Lieut.-Colonel Carty, R.A.S.C., who were returning to England on leave, were invited to accompany the party. As it was uncertain how much sand would be met with in the desert, it was decided not to take the armoured car escort which had been proposed.

Summary of journey.

Baghdad was left about midday on the 26th March, and after spending nights at Fallūjah, Ānah and Hadīthah, the party reached Dair-az-Zōr on the 29th. Here a day's halt was made for final preparations and to secure two Arabs as guides. On the 31st the journey was resumed, Palmyra being reached on 1st April, and Damascus on the 3rd. The total journey from Baghdad was thus accomplished in eight travelling days. The few Beduin met were quite friendly.

The surface along the camel route was on the whole suitable for motoring, but some twenty punctures were caused by the large amount of small sharp stones, which cover the face of the Syrian desert. A few wadis with sandy beds gave some trouble, and the mishaps included a broken radiator, a broken spring and other minor accidents. All repairs were carried out on the spot and all the cars reached Damascus.

Motor route sketch.

A route sketch was made from Dair-az-Zōr to the latter place. This was based on a latitude (35° 20′ 21″·6) observed at Dair-az-Zōr with a 6-inch micrometer theodolite to Polaris. The station of observation was on the roof of the Political officer's house on the south of the main street on the right bank of the Euphrates. A second latitude (34° 38′ 08″·0) was observed at Palmyra, in the courtyard of the *qishlaq*, N.W. of the Temple of the Sun. The latitude of Damascus was adopted from the value given by the Egyptian Intelligence Department. The leading car was fitted with a mileometer and compass. The former was carefully calibrated on a straight run of 72 miles. Near Ain-al-Baidha, nineteen miles on the Syrian side of Palmyra, an accident broke the mileometer beyond repair and distances had to be estimated by car speeds, checked by petrol consumption. The mean of two or three cars was taken.

Comparison with Hadīthah-Aleppo work.

Major Mason's observed latitude at Dair-az-Zōr was taken, it is believed, at or very close to Captain Lewis' station L. S. 52, of his Hadīthah—Aleppo triangulation described above.

The following are the two results:—

Lewis :	35°	20′	10·93″
Mason :	35°	20′	21·6″

The accordance is satisfactory as only a single star observation was made by Major Mason.

The motor traverse fitted in almost exactly between the observed latitudes of Dair-az-Zōr and Palmyra and Egyptian latitude of Damascus. But by adopting the value of longitude of Damascus as given by the

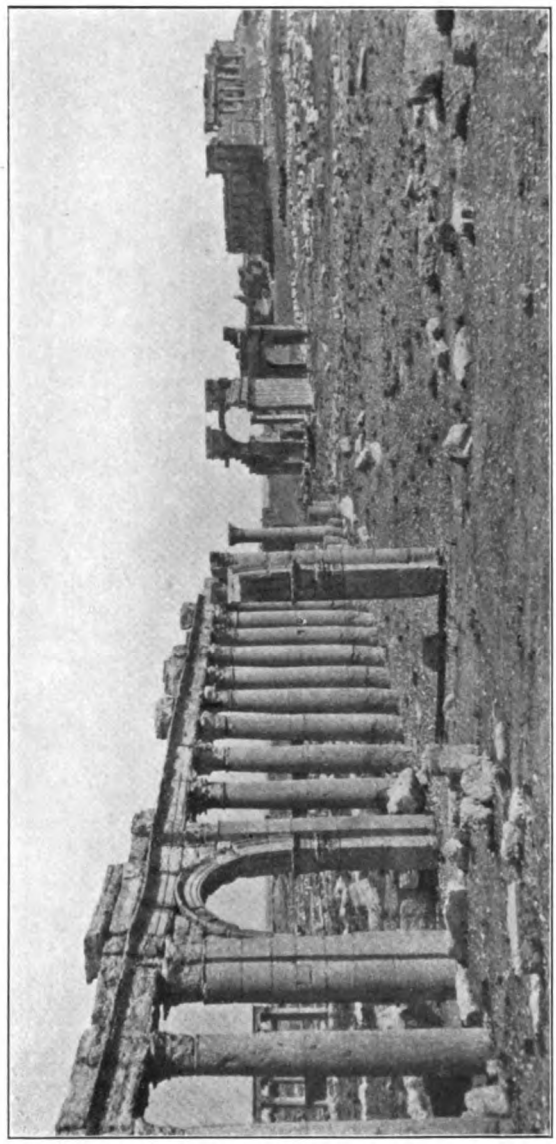
Egyptian Expeditionary Force maps, Dair-az-Zōr appeared to be relatively shown on existing maps nearly five miles too far east. This point has since been verified by the results of Captain Lewis' triangulation, which places Dair-az-Zōr some 4½ miles further west than its previously accepted position. The rough method of reconnaissance survey adopted by Major Mason gave surprisingly accurate results.

Salahīyah and Palmyra.

The journey lay over a route of great historical and archaeological interest. A short halt was made at the half-buried ruins of the old Roman-Parthian frontier town at Salahīyah. The desert gateway and citadel are in parts well preserved. But the most striking feature of interest on the journey was the ancient city of Palmyra, now inhabited by some 1500 sedentary Arabs of various tribes, engaged in the salt and potash trades. A great number of pillars remain standing, and some of the columns in the Temple of the Sun are almost as well preserved today, as when they were set up about the time of the Emperor Aurelian. Wonderfully carved fallen blocks of masonry recall the splendour and romance of Zenobia, who for a short period was mistress of an empire stretching from Lybia to the Persian hills.

On arrival at Damascus the party was somewhat delayed by the necessity for overhauling the cars, and after five days, a short tour was made to the main places of interest in Palestine. A copy of the military and route reports was despatched to Baghdad from Damascus, the original being handed in later to the Intelligence Branch at the War Office, London. The map was sent to the Director of Surveys, M. E. F., Baghdad.

PLATE 12.



THE MAIN COLONNADE AND TEMPLE OF THE SUN, PALMYRA.

[to face page 50]

CHAPTER VII

THE AFTERMATH

SEVERAL officers went on leave during the summer of 1919, amongst whom was Colonel Gunter. The latter handed over charge of the Directorate on the 22nd April to Colonel Pirrie, who had returned. In June occurred the death of Subadar Sayyid Razi Hasan, head clerk of the Directorate, a man of sterling character, and intense loyalty. He was a devout Shiah Muhammadan, and had just returned from a visit to Najaf and Karbala. The vicissitudes of the life of a pilgrim were beyond his strength. Though suffering from abdominal cancer, it was with the greatest reluctance that he gave up work and consented to be invalided out of Mesopotamia. He died a few days after his arrival at Karachi.

Death of Sayyid Razi Hasan.

After the Armistice, a gradual reduction of the forces in Mesopotamia took place, and all departments were much reduced in numbers. Nevertheless conditions were by no means peaceful. The vast area to be administered, the transfer of control from a military to a civil administration, the difficulties of demobilization, and above all, the delay in settling the future of Mesopotamia and Kurdistān, all these factors contributed towards restlessness for some time to come.

By April surveys between Kirkuk and the Persian frontier had been in progress for several months, and it was anticipated that they would be completed in June. Preparations for extension to Rowandūz were in hand during May. Lieut. Pollet had been working west of Arbil between the two Zāb rivers, and the area between the Lesser Zāb, the Tigris and the Jabal Hamrīn had already been commenced. Relations of all survey personnel with the Kurds were most friendly.

Suddenly and quite unexpectedly on 21st May the rising of Shaikh Mahmud in Southern Kurdistān broke out. This chief seized the local treasury and arrested the political officer and his staff at Sulaimāni. All the country south of the Lesser Zāb was simultaneously affected. Conditions north of the river became unsettled during the next few days. Captain de Graaff Hunter, who was in charge of the surveys in these parts, marched from Rānia to Koi Sanjak on the 21st, where the news of the rising was received on the morrow. Accordingly he left for Arbil, withdrawing surveyor Abdus Salam who was working thence towards Shaqlāwah. Rumours, current at Arbil, of the capture of several surveyors were confirmed at Kirkuk on the 26th. It transpired during the succeeding days that Jemadars Jagannath, Farman Ali, Tula Ram, Purdil Khan and Amar Singh had all been taken captive on the

Shaikh Mahmud's Rebellion.

21st. The Political officer of Sulaimāni, with all British and Indians present, was imprisoned there. Already, after an abortive effort of the local troops to relieve the town, a force under Major-General Fraser was being assembled at Kirkuk.

Captain Hunter communicated with the local general staff, but found that no rescue work could be undertaken for his surveyors. Several R.A.F. planes had arrived by this time, and as he had passed through a Lewis gun course, he was allowed to accompany these as guide and gunner, in several bombing flights over the country. From his knowledge of the sites of the various surveyors' camps he was able to make a fairly complete plan of the villages, which was very useful at this juncture.

Escape of Surveyors.

Jemadar Purdil Khan, held captive at Tilyān, turned the opportunity to good advantage, asserting that the bombing machines had arrived for him; by this piece of strategy he induced his captors not only to release him, but also to provide him with transport. He arrived at Kirkuk in due course with his planetable and all kit complete. About the same time Jemadar Tula Ram succeded in escaping by night, and, after an arduous journey of forty miles conducted entirely during darkness, he reached the same town with his khalasis. He brought his planetable section but had to abandon all his kit. Jemadar Amar Singh at Mamshāh contrived to arrange his release on payment of a sum of money and arrived on the 31st. At this stage there was no precise information as to the whereabouts of Jemadars Jagannath and Farman Ali; but it was presumed that they had been taken to Sulaimāni, as was actually the case.

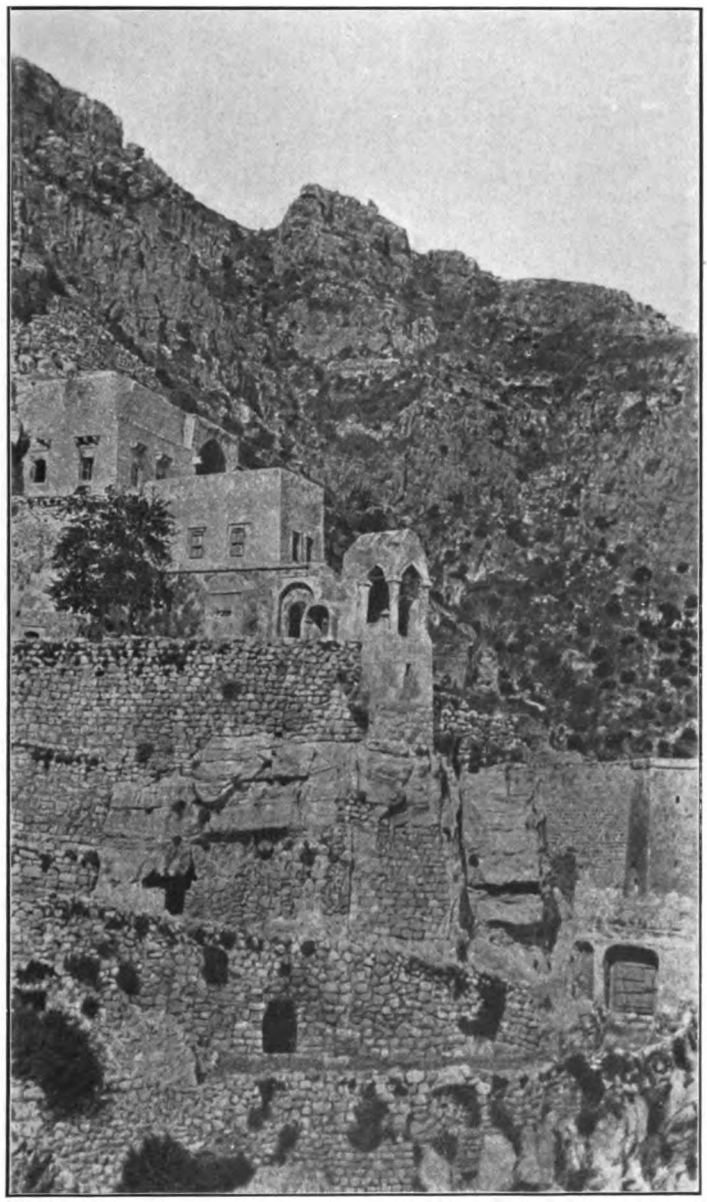
The devotion to duty of these three surveyors, Purdil Khan, Tula Ram and Amar Singh not only in affecting their escape, but in bringing in the results of their work is worthy of especial record. Their surveys were immediately sent to Baghdad for reproduction, and the resulting map proved of the utmost value in the subsequent fighting. Captain Hunter was also able to produce a rough map of the Baziān pass for the engagement there.

Since ordinary surveys east of Kirkuk were now in abeyance, Captain Hunter recalled Lieut. Pollet from Arbil for the supervision of surveys to the west, and himself attended to military requirements. He was able to indicate several improvements of alignment of the Kirkuk-Chemchemāl road which facilitated motor transport. He joined Fraser's Force at Chemchemāl, but returned to Kirkuk to accompany the aeroplanes, taking part in the Baziān engagement, where the insurgents were defeated. Later he went on several punitive flights to Halabja and Sitak, locating the latter village and flying about 1000 miles in the course of these operations.

Relief of Sulaimāni.

Sulaimāni was relieved on the 19th June, after which demonstrations were made in the surrounding country. About the same time a column arrived from Quraitu, near Qasr-i-Shīrīn, via Halabja. Lieut. Kitchen with two surveyors accompanied this force, while Captain Hunter provided surveyors for the others. The triangulation of this area

PLATE 13.



THE MONASTERY OF MAR MATTAI, ON THE JABAL MAKLUB, 15 MILES N.E. OF MOSUL.

[to face page 52

had been completed before the rising occurred. Moreover Jemadars Jagannath and Farman Ali had preserved their surveys during their captivity and reproductions of these arrived from Baghdad. The surveyors with the columns were now able to fill in most of the gaps, so completing the Sulaimāni-Halabja-Tashluja area.

Jemadar Jagannath triangulated Sulaimāni and to the south, air photos of the town being adjusted on his points. Triangulation for the towns Kirkuk, Koi Sanjak, and Arbil had been previously executed by Captain Hunter, and for Altūn Kūpri by Lieut. Pollet. Mosaics of all these towns were produced in due course, and the conversion of these mosaics into ground plans was carried out by Havildar Muhammad Hasan.

During the course of the work of this survey section, the political officers, Captain Longrigg at Kirkuk, Captain Murray at Arbil, and Major Greenhouse at Sulaimāni gave constant assistance. Khan Bahadur Sher Jang of the Survey of India was temporarily attached to the Political department during the operations, and was employed at Halabja and Sulaimāni.

Captain de Graaff Hunter, to whom great credit is due for his work in this area, having been granted leave, handed over charge of the survey round Sulaimāni to Lieut. Kitchen on 9th July, and that of the western area to Lieut. Pollet at Kirkuk on the next day. The latter was however in indifferent health and was shortly afterwards invalided to India.

Trouble north of Mosul.

Meanwhile there had been trouble north of Mosul. The Goyān, a very inaccessible tribe near the Armistice line, treacherously betrayed and murdered the political officer. It became evident that a large number of tribes were involved in a rising to test the power of the British to maintain order. In consequence, it was decided to traverse the whole area of the insurgent tribes and to punish those directly concerned in the outrage. The situation was complicated by the murder of the assistant political officer, the gendarmerie officer and one British N.C.O. with their servants and certain Christian gendarmes, on the night of 14th July.

Throughout the summer and autumn, punitive operations were in progress. The country was most difficult and precipitous, the hills being rocky and jungle-clad. Every day's march implied the ascent and descent of two or three thousand feet. But at last the whole district was penetrated and the recalcitrant tribes punished. Order was restored towards the end of September.

Mention has been made in Chapter V of Lieut. Booth's work in this area. As may be imagined, he found the conditions much disturbed during the whole course of his work. He and his surveyors had to keep in constant touch with the political and military situation, and more than once his surveyors had to be recalled owing to the presence of marauding tribes. The work allotted to this section was completed except for a small area west of Zākho by mid-June, Lieuts. Booth and Murphy and all but one surveyor returning to Baghdad during the middle of that month. The extension of operations, however, gave an

opportunity for fresh surveys, and Lieut. Kitchen, having completed his work in southern Kurdistān, accompanied the 18th Division to the district between Zākho and Amādia, remaining there till the end of October.

Disturbances at Nāsirīyah and Dair-az-Zōr.

There were also disturbances below Nāsirīyah on the Euphrates in the spring of 1919, but energetic measures quickly pacified this area. Far up the same river, too, there was an outbreak which led to the seizure of Dair-az-Zōr and the imprisonment of the small British detachment stationed there. The operations resulting from this situation continued far into 1920. They were however confined to the vicinity of the river itself, which had already been mapped and they therefore afforded little opportunity for extensions.

Surveys on the borders of Pusht-i-Kūh.

Blanks in the detailed survey of other parts were meanwhile being filled, and large scale photo-surveys of cantonments and towns were being carried out. In spite of the many requirements, reductions in staff were taking place owing to the necessities of economy. However, during the winter of 1919-20, Subadar Hayat Muhammad, K.S., and his brother Jemadar Khan Muhammad, extended the triangulation along the borders of the Pusht-i-Kūh country, between Mandalī and Harūnābād. Here too, the ground was very difficult, water was scarce and brackish, and the attitude of the subjects of the Wali of Pusht-i-Kūh uncertain. The latter had maintained a neutral attitude throughout the war. He was in a difficult position, and was anxious that hostilities should not extend to his territory. Although repeated efforts had been made to survey his land, it was not until early in 1920, when the Anglo-Persian Oil Company asked for a survey party to map the country at their expense, that an opportunity was found to do so. The Company was aware that in certain spots traces of oil had been found, and after some correspondence with the Wali, obtained his permission to send geologists to report on these localities. At the end of March 1920, the matter was finally settled, and it was arranged to send Lieut. Strong with four Indian surveyors and 24 menials to the Pusht-i-Kūh. Two British geologists were sent with Lieut. Strong by the A.P.O.C. An account of this detachment will be found in Chapter X.

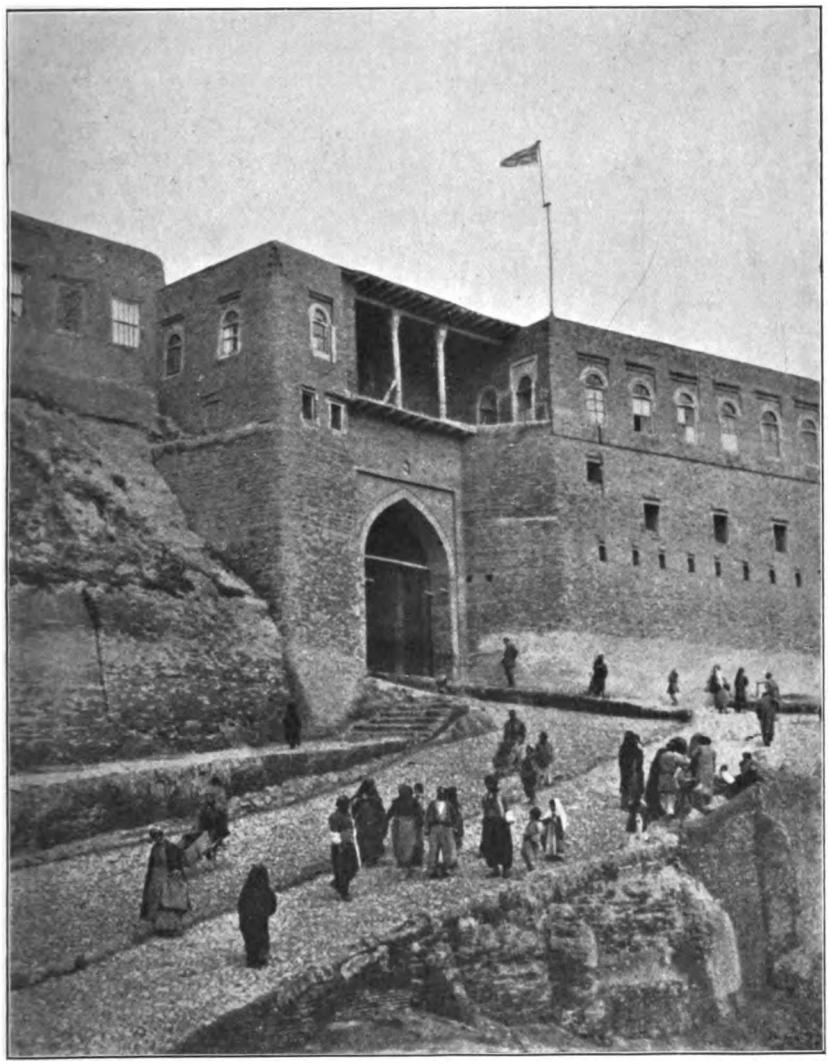
New Survey offices at Baghdad.

In the autumn of 1919, the Survey Directorate moved into new offices in the old Turkish cavalry barracks outside the North Gate of Baghdad, as the houses it had occupied were condemned. The new quarters required a good deal of alteration, which was carried out during the autumn.

Land Settlement and Revenue Survey.

One of the first requirements before the country could return to peaceful pursuits was some form of land settlement and revenue survey. During the war, a great deal of use had been made of air-photography to fill in topographical detail. In 1919, the Revenue Secretary, Lieut.-Colonel E. B. Howell, suggested that this method might be of use in a revenue survey, and Colonel Pirrie was asked to investigate the matter. The Map Compilation Section, whose special work had been the compi-

PLATE 14.



ENTRANCE TO ARBIL.

[to face page 54]

lation of maps from air-photography, had been disbanded in March, and almost all the experienced air-photographic officers of the R.A.F. had left the country. The Survey Directorate, owing to reductions, was only large enough to cope with the drawing, printing and reprinting of maps for which the field surveys had already been finished, and to undertake any absolutely necessary new field surveys that were required. For revenue purposes a great deal more work than for a military or topographical map was necessary; the complicated boundaries of estates and holdings of cultivators had to be surveyed carefully by the combined efforts of the Settlement and Survey staff. It was quickly realised that in level areas, urban or suburban, or elsewhere within one or two miles inland from the banks of main waterways, air-photography, if supplemented by ground surveys, might be justified, provided that the topography was an important factor and that observers could photograph during their normal duties. In the winter of 1919-20, the R.A.F. was approached, but was unable to carry out the work owing to lack of planes and personnel. Survey by air-photography was therefore dropped.

The question of revenue survey by normal methods was now investigated. The framework of topographical triangulation carried out during the war was ample for the control of military maps. For a revenue survey under peace conditions, triangulation of a higher order was advisable. No personnel was, however, available in the country; no triangulators could be spared from Egypt; and enquiries for additional men from India for principal or good secondary triangulation were equally unsuccessful. The necessity thus arose of basing the revenue survey on the war triangulation. This varied locally in quality, according to the military conditions that existed at the time the work was done. In almost all cases, the exact station sites had been lost, owing to the action of the inhabitants, who removed the signals and marks as soon as the survey personnel left the ground; nevertheless the numerous permanent objects fixed by intersection, it was hoped, would serve as a framework for fresh triangulation and traverses for revenue purposes.

Metric system adopted.

It was proposed to use the metric system, which was formerly used under the Turkish administration, and which is understood by the inhabitants, for revenue surveys, with rectangular coordinates in units of twenty metric chains. The most suitable origin in Central Mesopotamia was latitude 32°, longitude 46°, a point well situated with reference to the principal areas of cultivation and probable sphere of irrigation development. It was intended to carry out main theodolite traverses, starting from and closing on points fixed by triangulation. The orientation of each block would be maintained by astronomical azimuths. As mentioned in Chapter V, precise levelling was carried out in 1918, and the benchmarks fixed should be ample for all purposes for many years to come.

The marks considered suitable for revenue survey consisted of large bricks, hexagonal for main theodolite traverses, cylindrical for other traverse stations, and triangular for triangulation stations. Square brick pillars were proposed for the 10-kilometre blocks, with smaller ones for the corners of 2-kilometre blocks. It was also intended to mark estate boundaries as a temporary measure by conical mud pillars, to be

whitewashed when accepted as correct by the Settlement.

Consideration of various systems.

Colonel Pirrie now made a careful examination of various revenue survey systems, receiving great assistance from the notes of Major F. C. Hirst, I.A., Director of Surveys, Bengal, from a book entitled "The Cadastral Survey of Egypt, 1892-1907," by Captain Lyons, F.R.S., and from a note by Colonel Crichton, C.I.E., I.A., on Cadastral surveys for the Chinese Government. The climate of Egypt and the plains of Central Mesopotamia are very much the same, and the conditions of the latter in 1919 were somewhat similar to those which existed in Egypt before the cadastral survey was started. In India, this type of survey has been very highly developed, but it has not yet been possible to find a system for revenue purposes that is universally applicable to the diversity of climates, races, and forms of government. For these reasons, it seemed more suitable to frame the general system of revenue surveys in Mesopotamia on Egyptian practice, and to introduce where possible, minor improvements from the best systems in use in India. All the latter are designed to employ a large number of nearly illiterate men on small pay for one particular purpose and for that only. Under proper supervision these men can secure very satisfactory results.

The character of the Arab does not lend itself to application and continuous hard work. The literate *effendi* of Baghdad is very quick at assimilating knowledge, but hates to work away from the principal towns, or in rural areas, where he is looked down upon by the tribesmen The desert Beduin will of course do no manual labour. The illiterate rural cultivator will often work readily enough near his home, but if asked to work at a distance, would rather resign his post than do so.

Survey school at Baghdad.

Weighing up all these considerations, it was decided to train literate Arabs and Baghdadis at a central school and training camp near Baghdad, and distribute them, when taught, among the principal administrative centres of Mesopotamia, where with the local *Tapu* staff they could train others to meet local requirements.

Training was started at Baghdad in the autumn of 1919, after preliminary discussion with the Revenue Secretary and the Directors of Survey and Education. It was hoped to obtain Arabic-speaking officers and surveyors from Egypt to act as instructors, but these were not forthcoming, and Captain L. B. Fitzgibbon and some cadastral establishment were obtained from India. The candidates who presented themselves for training consisted principally of *effendis*, a few of whom had been officers in the Turkish army in the war; and although there were a few men from out-stations, most of them were residents of Baghdad.

System of Instruction.

The system of instruction arranged was very similar to that of the technical schools in America, viz., a fortnight's instruction in theory and book work, and then a fortnight at a training camp. The pupils were divided into two batches, alternatively working at the Baghdad school and at the Diyālah camp. In February 1920, that is, after three months' instruction, an examination was held, and of the one hundred pupils, the

first fifty were selected for more extended training. In April, the course of instruction of these fifty was recommenced and continued for a further three months. At the conclusion of the course, thirty-one students were considered fit to be finally tested in the field. Of these four failed to appear and the remaining twenty-seven passed creditably.

The other pupils of the school who were considered suitable as draftsmen, for photo-litho map reproduction or for photography, were also tested, and those likely to be of use were taken into employment.

Meanwhile, a cadastral survey was started in the northern part of the Baghdad Civil Division at first under Lieut. Morton, and later under Subadar Puri. The area traversed and surveyed in detail was as follows:-

Scale 1/2500	1900 donums.*
Scale 1/5000	26436 donums.

During the same period a second cadastral survey section under Lieut. Booth worked in the Hillah division between Hillah and Karbala, traversing and surveying 55,225 donums on the scale 1/5000.

The Arab rising of 1920.

While these surveys were in progress, the Arab rising suddenly blazed out. Samāwah and Rumaithah in the Euphrates area were isolated. The outbreaks spread northwards and the tribes west of the Hillah branch of the river rose in revolt. Soon a very large part of Irāq became involved, the outskirts of Baghdad itself being put into a state of defence. On the Diyālah the railway was cut and Bāqubah was attacked and looted. The tragic massacre of the administrative staff at Shahrāban after a defence of three days, during which time the Arab levies stood loyally by their officers and fell with them, was repeated at Kifri. It was not till the end of August that the Bāqubah-Quraitu area was reoccupied by troops and not till October that order was restored on the Euphrates.

These disturbances were in a measure agrarian. All cadastral and settlement work was indefinitely suspended and the further training of revenue survey pupils ceased. The Directorate, however, engaged six of the students who had passed through the survey school; thirty others were employed in the *Tapu* Department, two in the Arab army, and four under the Works Directorate in the Awqaf and Irrigation Directorates. Altogether forty-two of the survey students were therefore employed in useful work under the Mesopotamian Government and good reports have been received regarding their work; so that the great care and trouble taken in their training has not been altogether thrown away.

* * * * * * *

Conclusion.

At this point it seems desirable to close the record of the achievements of the Survey of India during and after the war in Mesopotamia. In view of the disturbed conditions prevailing for some years after the Armistice, it is not easy to draw the line between war and peace. But with the conclusion of the Arab rising of 1920 it may be said that

* A donum is a square of 50 metre sides.

Mesopotamia at last entered on a period of peaceful administration and reconstruction.

The Survey of India has not entirely withdrawn its personnel, nor has it by any means lost interest in Mesopotamia. In 1921, Major L. G. Crosthwait, of the Survey of India, visited Baghdad to discuss the requirements of the civil and military authorities. There was little work at that time being done for the Settlement, but maps were in progress for irrigation purposes and for the Anglo-Persian Oil Company. The whole directorate was now operating under the Ministry of Communications and Works, and was suffering from a lack of funds. It was decided to leave a small staff under Mr. B.C. Newland, Survey of India to complete the maps still required for the Army and Air Force in Mesopotamia itself, but to transfer to India the preparation of Persian maps.

PART II.—PERSIA

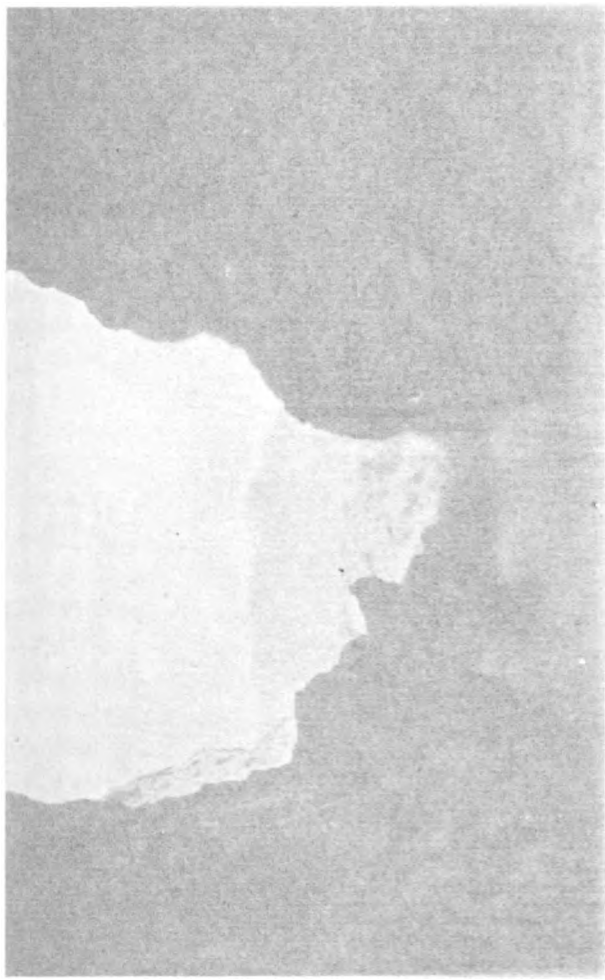
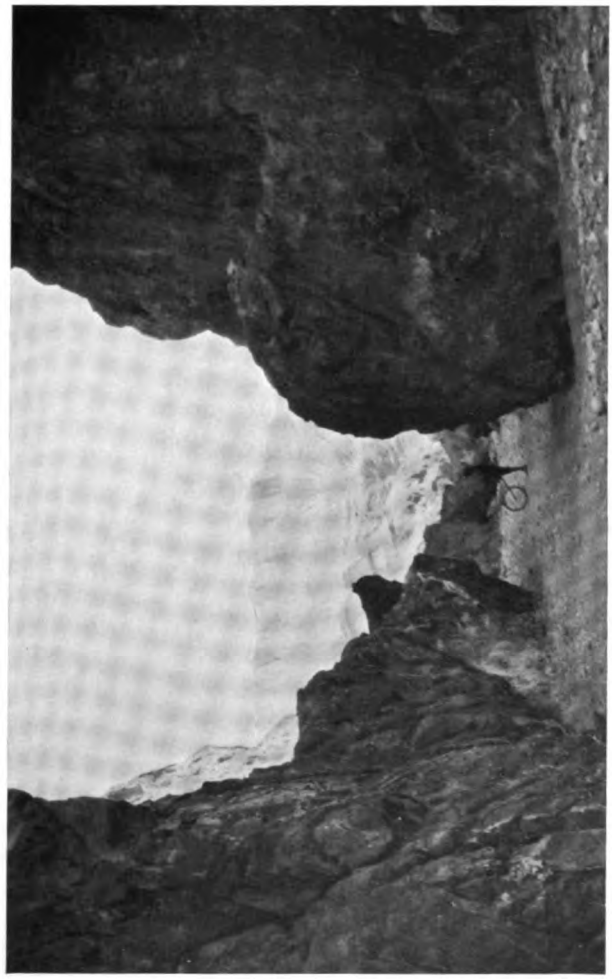


PLATE 15.



A NARROW PART OF THE CARAVAN ROUTE THROUGH THE TANG-I-ZĀGH DEFILE. (NOTE THE SURVEY COOLY WITH MEASURING WHEEL ON THE TRACK. AFTER HEAVY RAIN, WATER FLOWS 30 FEET HIGH BETWEEN THE ROCKS.)

[to face page 60]

PART II.—PERSIA

CHAPTER VIII

SOUTH PERSIA

STRICTLY speaking, Persia was not a belligerent in the Great War. And if Britain had had any say in the matter, she would have preferred that Persia had been strong enough to keep the warring nations from her soil. Various factors, however, led to the violation of neutrality, and the principles of self-defence caused the intervention of both Russians and British in their respective spheres of interest.

German Propaganda in Persia.

Of these factors, it is sufficient to mention the insidious propaganda of German agents, which permeated Persia, and which led to various murderous outrages on British and Russian consular officials and residents at Isfahān and Shīrāz. These agents, violating all principles of international law, boasted openly of their complicity in these crimes; and proclaiming that Haji Wilhelm, the Kaiser, and his subjects had been converted to Islam, they stirred up the ignorant population of South Persia, and thus necessitated the intervention of the British at the request of the Government at Tehrān.

The Anglo-Persian Oil Company.

The Survey of India was concerned with South Persia at the outbreak of war. The Anglo-Persian Oil Company, which had obtained valuable concessions from the Persian Government to exploit the oil resources in this area, had applied through the Home Government for surveyors to accompany their geologists. A detachment had actually been formed and was ready to sail, when orders were received cancelling the work.

Except in Arabistān, which was so intimately connected with Mesopotamia by reason of the Turkish threat to the oil interests*, South Persia did not reappear on the Survey of India horizon till the summer of 1916. By that time, Sir Percy Sykes had, at the request of the Persian government, organized the South Persian Rifles and the East Persian Cordon had been formed. Sir Percy Sykes had marched to Kirmān in May 1916 and re-established the normal state of affairs. From Kirmān he had gone to Yazd and thence to Isfahān and Shīrāz.

Persia Survey Party formed.

At this time there was in South Persia not a yard of made road fit for motor transport. Major E. T. Rich, R. E., Survey of India, was therefore ordered to Bandar Abbās in charge of a small party, termed the Persia Survey Party. The special object of his mission was to choose

* The Survey of the Kārūn and Ahwāz has been briefly recorded in Part I.

as rapidly as possible the best route for a motor road between Bandar Abbās and Kirmān, a distance of about 350 miles, and to frame estimates for rendering it fit for such traffic. He was directed to keep in touch with the local military and political authorities, who had been asked to assist him, and he was required to take all military precautions for the safety of his party. The British vice-consul at Bandar Abbās would arrange for his escort and assist him in the matters of supply and transport.

Programme.

If it had been possible, the most satisfactory plan would have been for Major Rich personally to examine all the existing tracks between Bandar Abbās and Kirmān and weigh their respective merits. Neither time nor the small staff at his disposal, however, permitted this procedure, and he therefore determined to :—

(*a*) ascertain from the local inhabitants at Bandar Abbās which tracks were most likely to prove suitable,
(*b*) examine and survey these tracks as far as possible, and
(*c*) finally make his decision.

The Survey of India personnel at Major Rich's disposal was as follows :—

Lieut. A. F. Murphy,
Subadar Sher Jang,
* Indian Surveyors: Abdul Aziz, Madad Husain and Gobardhun Singh.
* Soldier Surveyor Adalat Khan,
37 Punjabi khalasis.

Escorts were provided by the South Persian Rifles stationed at Bandar Abbās, and local donkey transport was hired. Major Rich received his orders at Simla on the 6th November 1916, and reached Bandar Abbās via Karachi on the 15th. The remaining personnel with tents and instruments arrived on 1st December. Four months afterwards Major Rich reported by telegram the alignment of the route, which in his opinion was the best. He had personally travelled some 2000 miles over three main alternative routes, each of which was more than 350 miles in length, and over a number of cross routes connecting them. By the middle of June the survey of the routes was completed and the party returned to India the following month.

The surveys were on the 1-inch scale except in difficult places where the 2-inch scale was adopted. Planetable traverses were made, all distances being chained, heights being observed by clinometer, and the ground for at least one mile on each side of the route being surveyed.

Nature of country.

The country between Bandar Abbās and Kirmān was of the same arid nature as in Baluchistān, varying in height from sea-level at Bandar Abbās to 5600 feet at Kirmān, with intervening passes, of from 7000 to 9000 feet high. Extremes of temperature were met with, from the bitter cold of the passes, covered with deep snow in the winter months, to the heat of the Persian Gulf in June. Most of the stream beds were

* Equivalent military ranks of Jemadar and Havildar according to standing in the Survey of India.

PLATE 16.

IN THE TANG-I-ZAGH DEFILE.

[to face page 62.]

dry, and when running water was found it was frequently brackish and unfit to drink. Vegetation was almost entirely absent except in patches round fresh-water springs and streams. Wood was very scarce and water was scanty along all the routes examined.

The outturn was as follows:—

(*a*) 2200 miles of track marched over and examined.
(*b*) 1231 miles of track chained and surveyed on the 1-inch scale.
(*c*) 73 miles of track chained and surveyed on the 2-inch scale.
(*d*) Surveys of Bandar Abbās on the 6-inch scale and Kirmān on the 4-inch scale.
(*e*) The drawing on tracing cloth of these surveys, comprising two complete sets of maps.
(*f*) Detailed estimates for the construction of three alternative motor roads over a distance of 1300 miles.

The total length of chained traverse of 1304 miles by two officers and four surveyors averaged 217 miles per man. The whole period from their arrival at Bandar Abbās to the completion of the work, inclusive of marching and wet days—about 10°/₀—comprised 196 days. Work was carried on from sunrise to sunset.

In his report Major Rich mentioned the good work done by Lieut. Murphy and Subadar Sher Jang, commenting on the excellent arrangements of these officers and their tact in dealing with the Persian officials and inhabitants. He also acknowledged the great assistance given by Mr. W. B. Howson, H. B. M. Consul at Bandar Abbās, and by Lieut.-Colonel Farran and Captain Ruck, Commandants of the South Persian Rifles at Kirmān and Bandar Abbās respectively, who supplied him with money, rations, and escorts, and assisted him in many other ways.

Selection of Tang-i-Zāgh route.

The result of these surveys led to the selection of the Tang-i-Zāgh route, as recommended by Major Rich, and a beginning was made to open this up. Unfortunately some delay occurred in despatching labour corps from India, as local labour was unobtainable in any quantity. When the Armistice was signed, only some 50 miles from Bandar Abbās had been prepared, while the Tang-i-Zāgh, which was the engineering crux to the problem, had not yet been tackled.

The very unsettled conditions in South Persia and lack of available survey personnel did not permit of any further survey work till late in 1918. In May of that year trouble broke out in the Shīrāz neighbourhood. During the same month the base at Būshire was organized. The force under Major-General J.A. Douglas was gradually increased, and an advance was made as far as Dalīkī at the foot of the mountains.

Towards the end of October this force commenced the march towards Shīrāz, and a junction was effected with the Shīrāz troops under Colonel Orton at Kazerūn.

South-west Persia Survey Detachment formed.

A Survey of India detachment under Lieut. F.H. Grant accompanied General Douglas' force. A column, designated the "Striking Force", had already advanced forty-five miles to Borāzjūn and was moving forward rapidly. The survey detachment, which comprised six surveyors, followed in the wake of this force, surveying the road itself and the

country on either side. One surveyor was detached in December for special reconnaissance duties under the Intelligence Branch, but the remainder continued the survey of the tract of country in the vicinity of the Būshire-Shīrāz routes until March 1919. In this month the greater portion of the Indian troops in South Persia were withdrawn, only small garrisons being left at certain points. The survey detachment however remained in Persia with a view to carrying out the following programme with Shīrāz as its headquarters:—

(1) Correction of the existing map within a 10 mile radius of Shīrāz.

(2) Survey of square A 3 in sheet 17, as far as a line through Arsinjān-Kavār, and south as far as Fīrūzābād.

(3) Surveys of the following roads:—

(*a*) Shīrāz—Karāmeh—Nīrīz.

(*b*) Shīrāz—Deh-bīd—Abādeh—Isfahān.

(*c*) Sarhad route from Shīrāz to Chashmeh Khusrau Shīrīn, north-west of Abādeh.

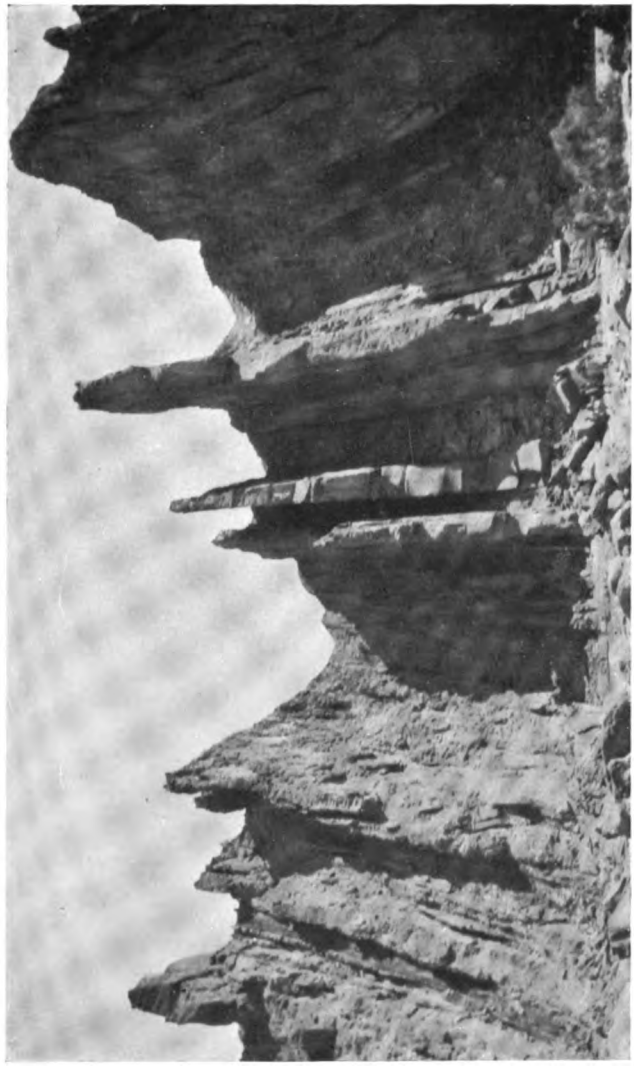
All these surveys were completed by the surveyors, working with tribal escorts arranged through the Governor of Fārs, except (3) (*c*) and the lower portion of (2), both of which areas were too unsettled. No serious trouble was elsewhere experienced, but two surveyors were fired upon. The chief difficulties were lack of water and the heat. The latter from June to September was severe, especially on the bare rocky hillsides, where the absence of water was also particularly felt. In addition, the warm weather is the unhealthiest time of the year in South Persia and the members of the detachment suffered from the prevailing diseases—sandfly-fever, malaria and jaundice. The last of the surveys on the programme, viz., the Shīrāz-Isfahān road, was completed by the middle of October, when headquarters were moved to Būshire, and the survey of as much as possible of the country left unmapped in the cold weather of 1918-19 was undertaken.

A surveyor was also attached to the column which was proceeding from Jāsk to Gwādar as escort to a telegraph repair party. This surveyor, Najmul Husain, succeeded in covering a large area, and his map has been useful in correcting the existing degree sheets which were at that time very incorrect. Work generally was considerably interfered with by rain, and by the presence of the hostile Khans, who lived close to the area where work was being carried on. In addition to the small scale work, a 4-inch survey of Būshire Island was completed.

Triangulation.

The whole survey is based on rapid triangulation, commenced from a base of 6470 feet measured near Būshire. This was connected with the existing latitude and longitude stations through Captain Crookshank's station at the Būshire Telegraph Office, and closed at Shīrāz on a base measured south of the city. An extension to Isfahān was also made, but this depends on resection from Captain Crookshank's triangulation executed in 1901-02 rather than on the series brought up from Būshire. The chief obstacles to triangulation in South Persia were the high winds and the dust-haze which prevailed from April to September. On several occasions a wall of stones had to be erected to windward before the

PLATE 17.



IN THE GORGE OF THE AHMADI RIVER, WEST OF THE TANG-I-ZINDĀN DEFILE.

[to face page 64]

theodolite could be set up. From after the first rainfall in November until March the air was particularly clear and the conditions ideal.

The number of stations observed at is 65, the number of intersected points 110, and the area of new triangulation 4800 square miles. The total area triangulated in this district is now approximately 10,000 square miles.

The total of outturn of detail survey was as follows:—

15,685 sq. miles on the ½ inch scale,
350 sq. miles on the 1-inch scale, and
24 sq. miles on the 4-inch scale.

In a letter to the Chief of the General Staff in India, Brig. Gen. A.B.H. Drew, G.O.C. Būshire Force wrote as follows:—

"The Southwestern Persia Survey Detachment has done most valuable work since their arrival in the country on 30th October 1918". The C.G.S. wrote afterwards, on 27th October 1920 to the Surveyor General: "The work done was of great assistance to the Būshire Field force at the time, as well as of permanent value as an addition to our maps and topographical knowledge of this region.

"His Excellency the Commander-in-chief considers that the satisfactory results achieved, reflect credit on Mr. F.H. Grant and all ranks of the Survey Party".

This detachment disembarked at Bombay on the 11th of May 1920.

Chapter IX

WEST PERSIA

MENTION has already been made of the Turco-Persian Boundary Commission which closed its labours on the eve of the outbreak of war with Turkey in 1914. It was not till two years afterwards, at about the time when the British were engaged in efforts to relieve Kut-al-Amārah that this area again claimed the attention of the survey authorities. The country was only very roughly mapped, and the Russian Commander, who was advancing towards Baghdad, asked for the assistance of a British survey party. Owing to the very large numbers of officers who had reverted to military duty, and the further large drain on the department for personnel for Mesopotamia, Salonika, East Africa, &c., it was not possible immediately to form a party.

Russian request for survey assistance.

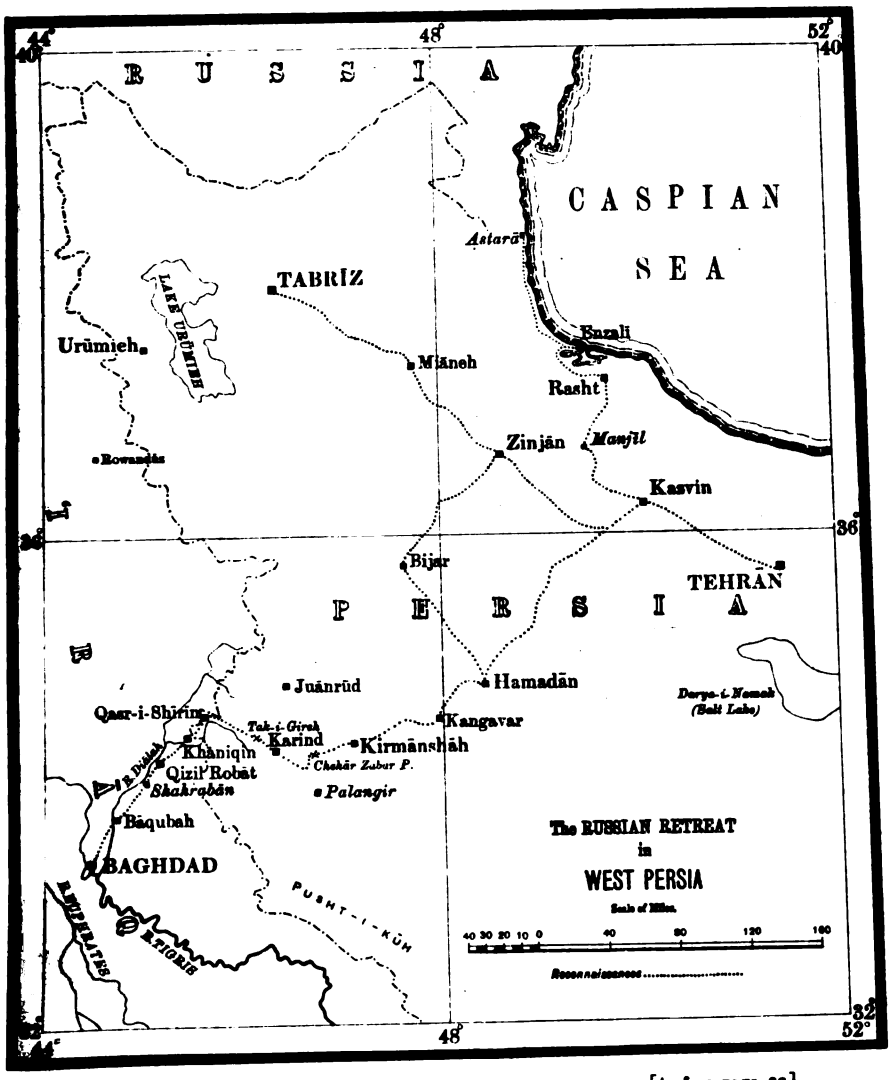
Early in February 1917, however, the Western Persia Survey Party was organized in India and proceeded via Basrah to join the Russian Army, then at Hamadān. The personnel eventually selected in India and those who joined later are given below :—

Western Persia Survey Party formed, Feb. 1917.

Major H. McC. Cowie, R.E., in charge to 30/4/17.
Captain W.E. Perry, R.E., in charge from 1/5/17.
Lieut. D.K. Rennick,
Subadar Hamid Gul,
Jemadar Laltan Khan,
Jemadar Khitab Gul,
Jemadar Ali Akbar,
Jemadar Gulab Singh.

The party assembled in Bombay on 28th February, but was not allotted passages till 6th March. On this latter date it embarked on H.T. "*Edvana*". Further delay occurred, however, as rumours were received of a German raider in Indian seas, and it was considered unwise to despatch boats singly. Accordingly the "*Edvana*" had to anchor in the harbour till a convoy was collected. Eventually on 13th March seven ships, escorted by the cruiser "*Pyramus*", started for Basrah, which they reached without incident. From here the party proceeded to Baghdad, but owing to further delays in transport up the Tigris, it did not reach the latter place till mid-April. Very shortly after arrival, Major Cowie unfortunately fell dangerously ill and had to be invalided back to India. Captain W.E. Perry, R.E., of the Mesopotamian Survey Party, who was then working at Fallūjah, on the Euphrates, was appointed to the charge, and took over the party at Baghdad on the 1st May 1917. Two more sur-

MAP VIII



[to face page 66].

veyors also joined from Surveys M.E.F., and sick khalasis were replaced. Rupees were changed into Turkish gold, and these latter after arriving in Persia to krans, as Persian money was not available in Baghdad, and rupees were not current in country not occupied by Indian troops. The services of a most excellent interpreter, Najaf Khan, were obtained. He hailed from Jāsk, had been an interpreter on one of H.M. gunboats during the suppression of the gun-running in the Persian Gulf, and held two British medals.

Preparations being completed, motor transport arranged, and final instructions received from the general staff, the party was ready to start off to join the Russians, who at this time had again advanced down the Hamadān-Baghdad road, and whose nearest post was at Qizil Robāt about 80 miles away. The furthest British post along this road was at Bāqubah some thirty miles from Baghdad, so there was a hiatus of some fifty miles to be crossed.

Party leaves Baghdad.

The party left Baghdad on the 9th May, a convoy of about forty Ford cars, with an escort of two armoured cars of the 14th Light Armoured Motor Battery; besides the personnel, kit and rations, some stores for the Russians were carried, and two car-loads of wireless stores for the Australian (Anzac) Wireless Section, which was already with the Russians. Bāqubah was reached that evening, and the next night Qizil Robāt without mishap, a special column having been previously sent out about 25 miles to Shahrabān to safeguard the route.

Qizil Robāt.

Qizil Robāt is on the river Diyālah, and at this time the Russians held the east bank and the Turks the west. The next morning when the L.A.M. Battery went out to bring in a derelict car from a few miles out of the town, both they, and later the town, were treated to a 'hate' from the Turkish guns. Things became lively, but nobody was hit. A little later the L.A.M. Battery and the motor transport left for Baghdad, and the party thenceforward trekked on foot, with local mule transport. Qasr-i-Shīrīn was reached via Khāniqin on 13th May, the Turco-Persian Boundary being crossed en route. Captain Perry here reported his arrival to General Radatz, commanding the 1st Cossack Division. Here also the Anzac Wireless Section under Lieut. J. White was met, with whom the survey party was afterwards associated throughout its stay in Persia.

Survey of Diyālah front.

After a week's delay, orders were received from the G.O.C. to survey along the Russian front on the Diyālah, and the party returned to Khāniqin to work under Lieut. Rennick, as the O.C. was sick. The heat about this time was intense, water being scarce in the area to be surveyed, and often brackish. Added to this, very great difficulty was experienced in procuring escorts, and such as were obtained were absolutely inadequate, usually only three rifles per surveyor. Even these men had to be pulled out of bed daily. Besides thus delaying the start of work they gave continuous trouble, asking for mounts, frequently running out of water, and then refusing to proceed. There was very little discipline left even at this early stage of the revolution, and at this distance from Russia.

Inhabitants hostile to Russians.

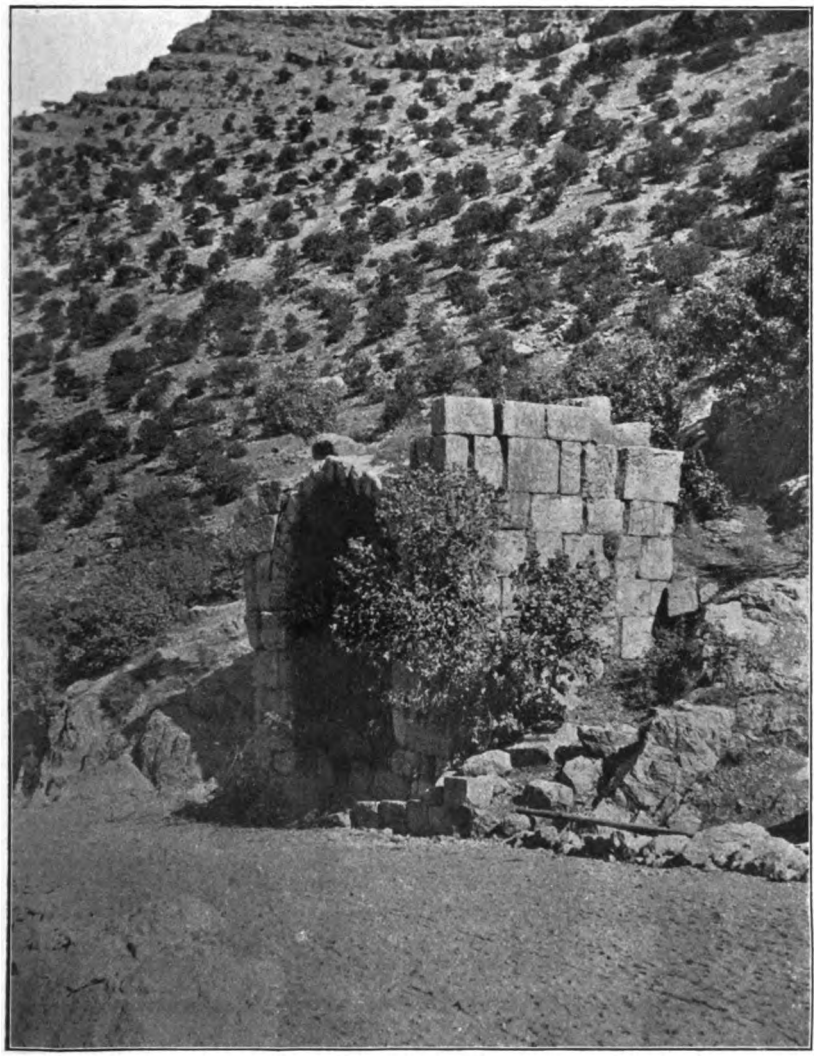
On one occasion a party with Lieut. Rennick was fired at by local inhabitants, who were everywhere hostile to the Russians, but nobody was hit. After work had been proceeding in this unsatisfactory way for about a fortnight it had to be stopped, owing to large bodies of hostile Arabs roving about in the districts under survey. Jemadar Khitab Gul, with an escort of three rifles, nearly walked into one of these bands, consisting of about eighty Arabs, and was lucky to get away unseen.

Indiscipline of Russians.

It was at this juncture, about 8th June, that the Russian rank and file decided to quit the Diyālah front, and forced the hand of the divisional general who had perforce to acquiesce. Undoubtedly it was not pleasant; it was very hot, and the troops had only fur caps and no sun-helmets; water was scarce and usually bad; there were no tents whatever, the only shelter available being improvised from pieces of thin canvas (about one to every three or four men), propped up with rifles and tied with bits of string, with bayonets used as tent pegs. Supplies were as short as the lines of communication were long; there was nothing to be obtained from the country, which had long ago been made barren by the Turks; and although a large quantity of grain was despatched by General Maude, this did not go far. The following dinner menu of the divisional head-quarters officers' mess for four consecutive nights is a sample of the straits to which the force was reduced:—first night, no dinner whatever; second night, boiled rice; third night, no dinner; fourth night, stewed apricots. In some places if food was available, fuel was not; practically the only wood obtainable was the timber supports from the flat roofs of the houses, and the thoroughness with which this source of supply was tapped can be vouched for by anyone who passed along the road from Khāniqin to Hamadān, where nearly every house, except in the towns, was a roofless skeleton. The combination of bad or uncooked food, or none at all, brackish water, unsuitable clothing, and a lamentable lack of even the most elementary sanitary precautions, filled the hospitals to overflowing with cases of sunstroke, typhoid and dysentery. There were no medicines, no medical comforts, not even milk for the enteric patients. The doctors were there, and some devoted Russian lady nurses, to whom life under the conditions that existed must have been a constant nightmare; without medicines however they were helpless. Practically every convoy with food and medical stores was attacked and looted by Kurds at some point on the long line from the Caspian; if they escaped the tribes, the supplies were requisitioned by units further back along the line. In short, the Russian soldier, small though his wants may be, was thoroughly "fed up", and ready to listen to the revolutionary orators in his regiment; every unit had its soldiers' council, which told him all about this newly established 'liberty and equality', brought into being by the revolution at home. Why obey his officers, and why stay to fight, or starve, or die of heat or fever down on the Diyālah, when he was a free agent to do what he liked? Why not go home? The G. O. C. and the officers generally were in a hopeless position; persuasion was tried, but ineffectually, and back they had to go.

It was General Maude's intention that both the survey party and

PLATE 18.



TAK-I-GIREH ON FARHAD'S SASSANIAN ROAD.

[to face page 68]

the wireless section should return to Baghdad, but the Russian troops at Qizil Robāt retired on their own, and the Turks got astride the Baghdad road and prevented the return, so there was no alternative but to retire into Persia with the Russians.

Qasr-i-Shīrīn quitted.

The survey party left Qasr-i-Shīrīn at 11 p. m. on the night of the 12th/13th June and marched till morning. Lieut. Rennick and Jemadar Laltan Khan were on the sick list, and had to travel in horse stretchers. The column was a long one, it was very dark, the road bad, and halts frequent. Sar-i-Pul, distant twenty-two miles, was reached at 8 a. m. the next day. Here there was a day's halt for the Russian rearguard to close up, and Subadar Hamid Gul was fortunately able to pick up a few of the Turco-Persian Boundary points on a previously plotted planetable. He started a road-area map and carried it through to Kirmānshāh, a very creditable performance, as he had many difficulties to contend with. Unfortunately he was just unable to join up with the Boundary Commission map round Qasr-i-Shīrīn, owing to the long march from Qasr-i-Shīrīn to Sar-i-Pul in the dark. No triangulation could be carried out as it was unsafe to move far off the road, and escorts were not obtainable.

Sar-i-Pul bas-reliefs.

Sar-i-Pul is on the Hulwān river, and on the face of the cliff upstream of the village are two interesting bas-reliefs. Neither are very easy to find; one is apparently considerably older than the other, being much worn. The more recent of the two is supposed to date from about 2,400 B. C., and depicts figures of men; the older one is a rough representation of a man and an animal.* Qasr-i-Shīrīn too is interesting archaeologically for its Sassanian ruins, the remains of a massive palace and the walls of the 'paradise' built by Khusru Parviz about A. D. 600. The walls are of massive unhewn limestone, locally obtained. Arab historians write of the vast 'paradise' and its many and rare animals hunted by this Sassanian king, who named the palace after his beautiful Christian wife, Shīrīn.

Tak-i-Gireh Pass.

On 15th June the retirement was continued to the top of the Tak-i-Gireh pass, first of all for some miles of fairly good going up the Āb-i-Mahit valley to Pā-i-Tak village, and then up a very steep and rough track for about a thousand feet to the pass. In places there were large boulders lying on the path, and many carts broke down; it was a marvel that the two heavy six-horse wireless waggons got up at all, but by putting in both teams on one waggon, and manhandling the wheels, they arrived on the summit, with horses and men dead beat.† An attack by Kurds was expected but did not materialise, and all that appeared was a Turkish plane, which came to see where the Russians were.

Alongside the track, about halfway up, is the arch or *Tak*, which gives its name to the pass. It stands about twenty-five feet high, and is built of large dressed blocks of stone, some of which are carved. There are many conjectures as to its object, but it is almost certainly of the

*These bas-reliefs it is believed are described in King's "*Sumer and Akkad*".
†This was, of course, before the road was constructed.

Sassanian period. This route is undoubtedly of extreme antiquity, and has been traversed by the armies of Babylon, Assyria, Media and Parthia in ancient times.

Russian artillery in action.

On the following day the party marched on through the long pass via Surkha Diza to Karind. Near the former place there was a brush with the Kurds who lined the summits to the north of the pass. There was a great deal of rifle fire and some pretty shooting by the Russian artillery, but as there were about two brigades of Russians there or thereabouts, the Kurds did not venture on a serious attack.

Halt at Karind.

There was a three days' halt at Karind. This little town is very prettily perched on the hillside at the foot of steep cliffs, and is well supplied with excellent water, which breaks through a cleft in the hills to the north, coming from a wonderful spring about three-quarters of a mile above. The little valley above the gorge, with its shady orchards and the streamlet rippling and splashing along in innumerable little cascades, seemed a veritable fairyland after the dreariness of Mesopotamia. The town itself, with its crooked climbing lanes crossing and recrossing numerous water channels, is very picturesque. It had suffered sadly from Turk and Russian alike and was largely deserted, while famine was staring the few remaining inhabitants in the face. The Khan, with whom very cordial visits were exchanged, was a very striking old man of about eighty years of age, with snow white hair.

Hassanābād.

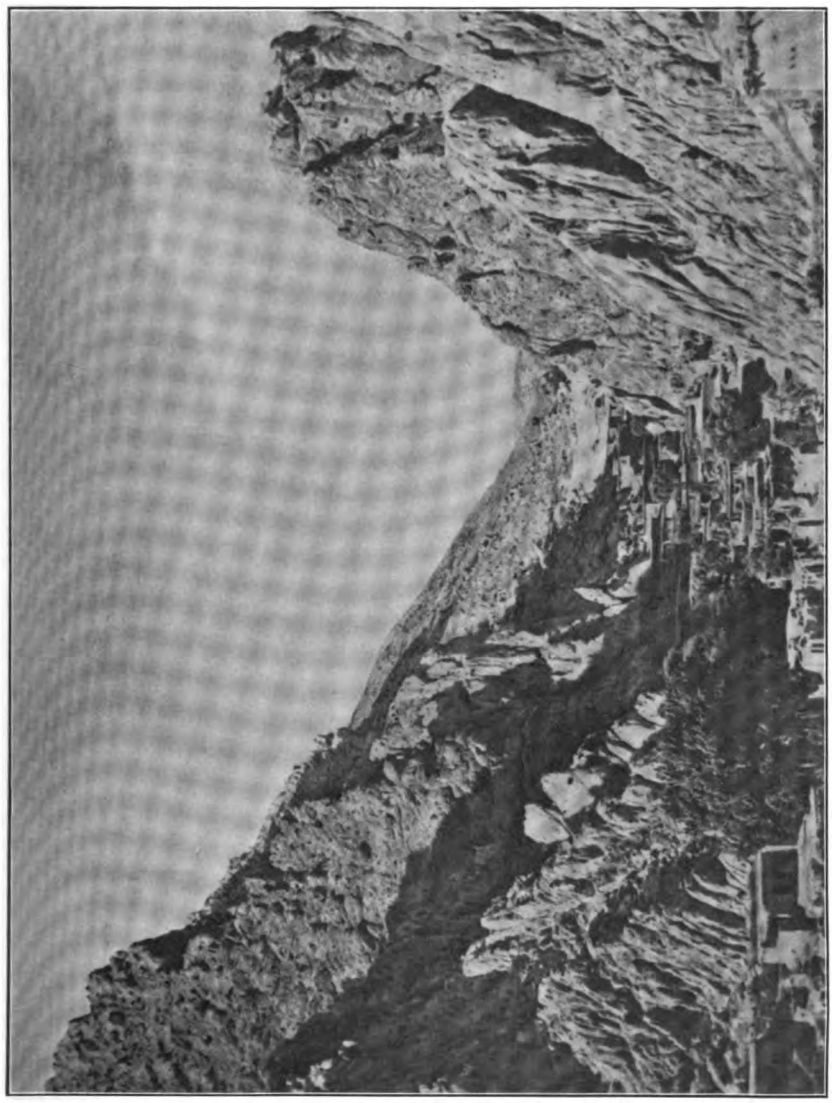
On the 20th the survey and wireless parties, with a special escort of some eighty Russians, marched about twenty miles to Harūnābād, and the following day to the hamlet of Hassanābād, about three miles short of a pass known as Chehār Zabar. After arrival at camp about noon, Subadar Hamid Gul went out three miles with his planetable, and his party was chased and fired at by Kurds; luckily they were not hit and returned safely. There were rumours amongst the Russians that there might be trouble with the Kurds at the pass the next day. During the night, Kurds eluded the Russian sentries, getting right into the camp, and stealing two Persian transport mules of the survey party, a considerable portion of Lieut. Rennick's small wardrobe, and a few odds and ends belonging to Captain Perry and the wireless section; they were astonishingly clever thieves.

Russians omit to picket Chehār Zabar defile.

On the following day, 23rd June, Māhīdasht, some twenty miles on, was to have been reached, but strong Kurdish opposition was met with in the Chehār Zabar pass. The Russian soldiers refused to obey their officers' orders to climb the hills on either side of the pass to see that they were unoccupied, and entered the defile ahead of the wireless and survey parties, with no military precautions, and no flank or rear guards. The Kurds were on the hills in force, and as soon as the head of the small column was well into the pass, they opened very heavy fire on the road, on which there was practically no cover.

The result was indescribable confusion. The Russians, being in front, got the worst of it, and those not hit poured back out of the

PLATE 19.



KARIND. WEST PERSIA.

[to face page 70]

survey and wireless parties went into camp in the garden of the British Consulate, the building itself having been destroyed by the Turks. The little British colony consisted of Colonel R. L. Kennion, I.A., the Consul, Mrs. Kennion, Captain Dewar-Durie, the manager of the Imperial Bank of Persia and his wife. None of the survey or wireless parties will ever forget their kindness throughout the stay of six months in Kirmānshāh; everything possible was done for the comfort of all, and much information and assistance was given, without which not a tenth of the survey programme could have been carried out. Much kindness was also received from the American Mission under Mr. Stead, his wife, and Miss Cowden. As the Russian hospitals were full, all sick were treated by arrangement at the mission hospital, where Jemadar Laltan Khan was an inmate for many weeks.

Kirmānshāh reached.

From this time the party had to make its own arrangements for rations and transport, owing to the impossibility of getting satisfactory rations from the Russians, though these at first gave advances of money to meet expenditure.

The first orders from the Russians, received early in July, were to survey the road from Kirmānshāh back to Karind. In order to start rigorous survey, a base-line was chosen and measured north-east of the town, a latitude and azimuth observed, and proper triangulation commenced; this was extended westward along the road, for the planetablers to supplement the work already done by Hamid Gul.

Survey from Kirmānshāh to Karind.

After one further trial of escorts from the Russians, which proved as unsatisfactory as the first, they were obtained by Colonel Kennion, who arranged direct with all those tribes which were friendly. In this way surveyors were able to get into much country which would have been impossible with a Russian escort owing to tribal hostility.

British Consul's help.

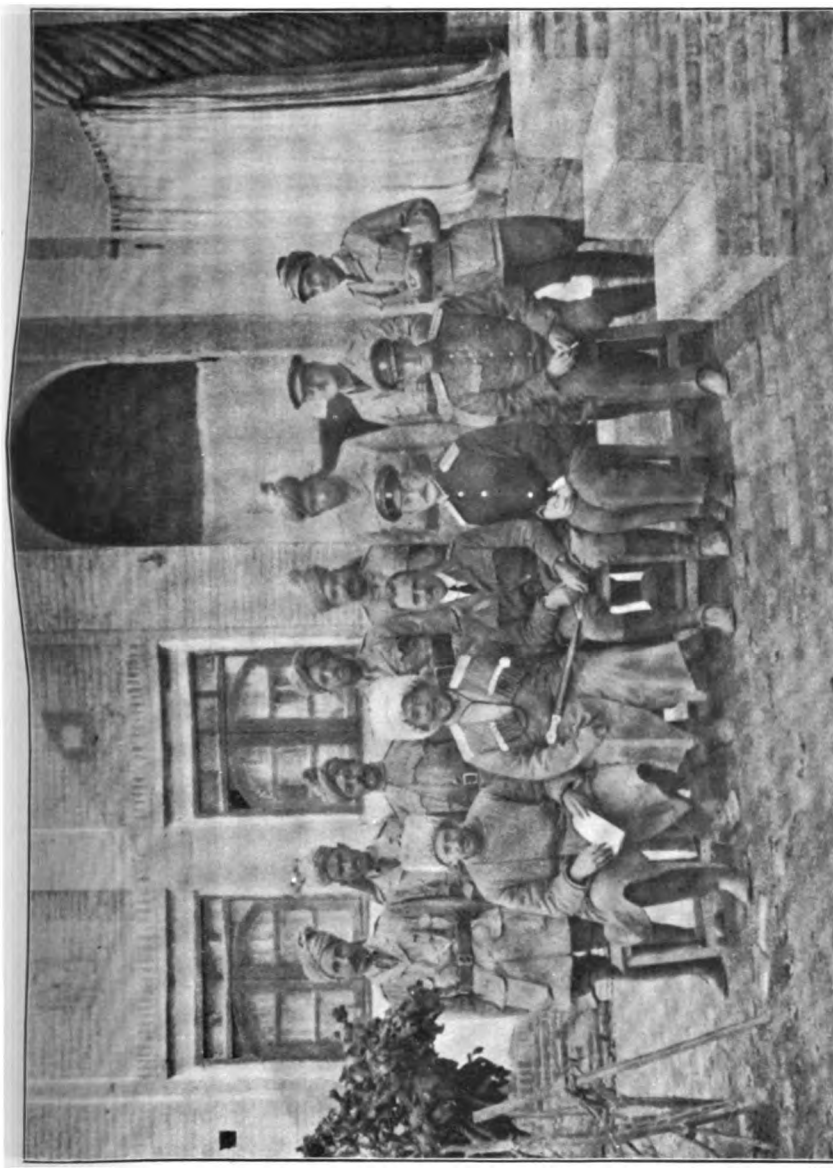
About the middle of July there was a big meeting between the Russians and the Kurdish tribes in the Sinjābi country about thirty miles north-west of Kirmānshāh, to attempt to establish friendly relations, and if possible evolve a '*Khassadar*' system for guarding the roads to Karind, where the Russian advanced post still was. Captain Perry, Lieut. Rennick, and Subadar Hamid Gul, accompanied Colonel Kennion and Captain Durie to this meeting, in the hope of being able to arrange with the Sinjābi chiefs to survey in their country.

Russians try *Khassadar* System.

Little work was possible on this occasion, but the cordial relations then established between the British party and the Sinjābis, resulted in the triangulation and survey of all this country to Ruvānsir and Juānrūd in September. Under Colonel Kennion's arrangements with other tribes the work was extended along the Senna road over thirty miles to Marwārīd, in the Ahmadavand tribal country, and westward a similar distance to Gāhvāreh in the Gurān tribal area, all of which surveys were particularly asked for by the Russians. Other surveys required by them—completed in August, and the results supplied to the general staff—

Areas surveyed.

PLATE 20.



GENERAL BARATOFF AND THE WESTERN PERSIA SURVEY PARTY.
SEATED, LEFT TO RIGHT.—(RUSSIAN RED CROSS), GEN. BARATOFF (C. IN C. RUSSIAN FORCES), CAPT. PERRY (O.C. SURVEY PARTY), BARON TCHERKASOFF (RUSSIAN CONSUL, KIRMĀNSHĀH), LIEUT. ZAPAVLOFF (A.D.C TO GEN. BARATOFF).
STANDING, LEFT TO RIGHT.—SUB. LALTAN KHAN, JEMS. ALI AKBAR, NAJAF KHAN, GULAB SINGH, KHITAB GUL, SUB. HAMID GUL, LIEUT. RENNICK (SURVEY), LIEUT. WHITE (ANZAC).

[to face page 72]

were from Kirmānshāh southwest about ten miles to Zailān, and along the Baghdad road as far as Harūnābād. The original extension asked for along this road to Karind was not carried out, as the Russians had retired to Harūnābād before this section could be reached*. In August surveys were also started in tribal country east and southeast of Kirmānshāh, from the Hamadān road to the Kūh Safīd. Traces of all work completed to the end of August were despatched by special messengers to Baghdad via the Pusht-i-Kūh country, in case the party should experience any further episodes of the Chehār Zabar type, and lose its original records and maps. There had been no inter-communication with Baghdad, except by wireless, since before Qasr-i-Shīrīn had been quitted in June.

Wireless longitudes.

On the nights of 31st August and 1st September special prearranged signals were sent out from the big wireless station at Basrah and received by Captain de Graaff Hunter at Fāo, Colonel Pirrie at Baghdad, and Captain Perry at Kirmānshāh, in order to determine the longitudes of the two latter places, that of the first being known. The signals were repeated later on the nights of 10th and 12th October, and good longitude determinations were made. A small 'pukka' pillar, with upper and lower markstones, was built at the station of the triangulation where the star observations for time were taken in connection with this longitude work†. A star latitude was also observed at this station.

Tak-i-Bostan bas-reliefs.

About this time some of the party were enabled to see the famous rock sculptures of Khushru Parviz and others at Tak-i-Bostan, at the foot of the hills about seven miles north-east of Kirmānshāh. The main sculptures are contained in two arches cut in the limestone spur. The smaller dates from about A.D. 400 and the larger from about A.D. 600; this latter is over thirty feet high, and about twenty feet deep, and the carvings on the inner face depict Khushru himself, while those of the two inner sides are of hunting scenes. Close to the sculptures there is a very fine spring.

Capt. Perry reports to General Baratoff at Hamadān.

Early in October, Captain Perry proceeded to Hamadān for a few days to take copies of the new maps to General Baratoff, the Russian commander-in-chief, and to interview Colonel Rowlandson, the British military attaché, on various matters. At the same time he wished to get some warm clothing for the detachment, and to settle up the question of payment of mule transport, over which there had been considerable difficulty with the Russian staff at Kirmānshāh.

Bīsitūn rock carvings.

The distance to Hamadān is nearly 120 miles. At twenty-one miles the Bīsitūn cliff is passed, where there are carvings of great archaeological interest. The main sculpture—there are two—is on the face of the cliff some three hundred feet above the road; it was carved by order of Darius the Great about 500 B.C. to celebrate his military achievements,

* The junction with Mesopotamian work was completed later by Capt. de Graaff Hunter, *see* Chapter X.

† For results see chapter IV.

and has trilingual inscriptions in ancient Persian, Susian and Babylonian. The tracing and study of this inscription by Sir Henry Rawlinson led to the first complete decipherment of cuneiform writing. The lower carving, though more worn is probably Parthian.

The classical Ecbatana.

Hamadān itself is the classical Ecbatana, dating back to at least 1100 B.C. Practically nothing is now visible of the ancient Ecbatana except the palace mound to the east of the present town, and the weather-worn remnants of a stone lion. The tombs of Esther and Mordecai are in the town, and are well preserved and cared for.

General Baratoff compliments the Survey.

General Baratoff and the Russian general staff were all very interested in the maps, and surprised and pleased with the amount that had been done under difficult conditions in so short a time. Captain Perry was thanked personally by General Baratoff, and complimented on the work of the surveyors, especially that done by Hamid Gul in the neighbourhood of Juānrūd, which was a dangerous area often visited by the Turks, who had outposts in the vicinity. The Russians had only a small scale map of Western Persia, and probably no trained surveyors at all with them; a few attempts at reconnaissance work in very small areas had been made, but the results were of a very elementary nature.

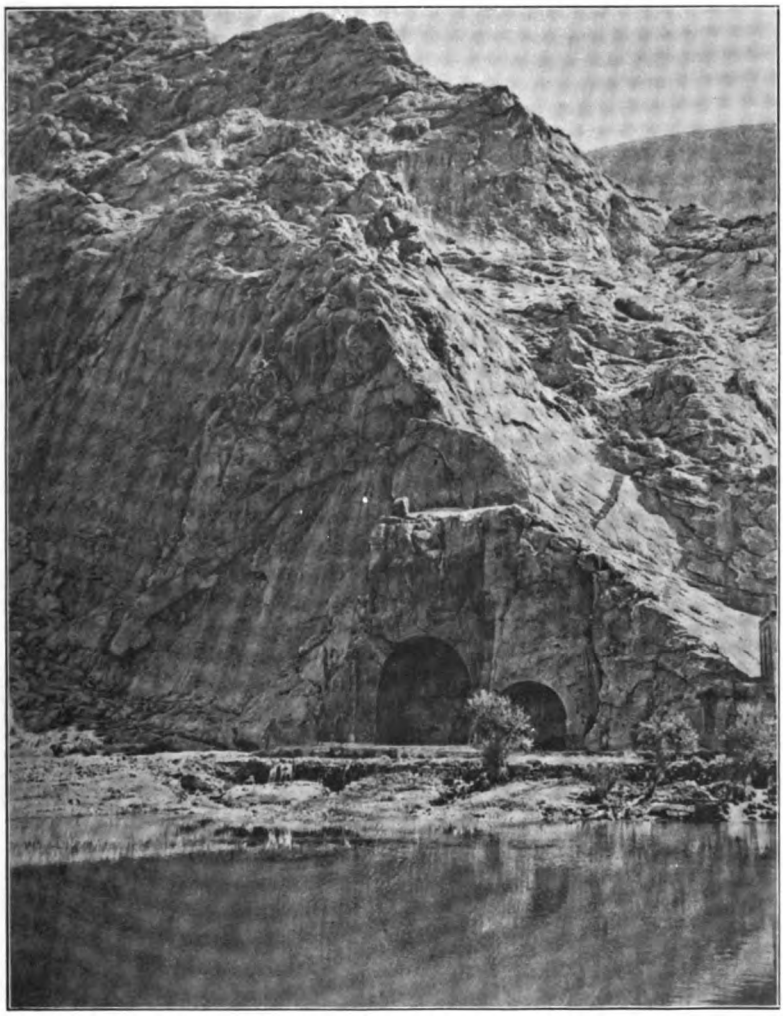
Extensions of survey Sept., Oct. 1917.

During the latter portion of September, in October, and early November, very large extensions of the planetable survey were carried out; to the north-east, east and south-east of Kirmānshāh, i.e. the country round Bīsitūn, beyond Sahneh, and in the neighbourhood of Harsīn; to the south-west, towards the Pusht-i-Kūh, in the vicinity of Shīān, Palangir and Muminai, and a large area further west to Gilān, where a junction was effected with the Turco-Persian Boundary Commission survey.

A good record.

This work would have been impossible except for the tribal escort arrangements made by Colonel Kennion, who on several occasions took surveyors with him on his tours, and throughout evinced the keenest interest. There were several occasions when survey detachments were fired at, chiefly in the Gilān area, where Subadar Hamid Gul's detachment had several escapes, but there were no casualties. The work done by this officer was exceptionally extensive and fine throughout and for this he thoroughly deserved the awards of the title of Khan Sahib and the Russian order of St. Anne, 3rd class, which were subsequently made. The other surveyors all did good work; unfortunately Subadar Laltan Khan, whose record of previous survey work in Mesopotamia was remarkably fine, was very ill for some time, and it was only towards the end that he was well enough to go out with a planetable. Lieut. Rennick very successfully carried out the triangulation that was possible, and in June and July when the O.C. was sick, took charge of the party arrangements. A great deal of the office and quartermaster's work of the party was very ably carried out by Jemadar Gulab Singh, who for this, and subsequent meritorious work, was promoted to the Upper Subordinate Service. Khalasi-dafadar Mirza is also worthy of

PLATE 21.



THE SASSANIAN GROTTOES AT TAK-I-BOSTAN, NEAR KIRMĀNSHĀH.

[to face page 74]

special mention for excellent service throughout.

Russian situation grows worse.

The situation through the autumn had been steadily growing worse, and it became increasingly difficult to obtain money from the Russians to pay for rations and transport. After the end of October no more money could be obtained, and a credit had to be arranged through the Imperial Bank of Persia by cheque on Basrah. On 20th November, a telegram was received from Colonel Rowlandson at Hamadān that G.H.Q. Baghdad wanted the survey party to return, and that General Baratoff having agreed, work was to be closed down and preparations made to return via the Pusht-i-Kūh. On the 21st General Baratoff arrived in Kirmānshāh; he intimated that he would like to see all the officers of the party to say goodbye. The General asked to be introduced to all the Indian officers and was photographed with them. Addressing the party he thanked them for the 'excellent and artistic work' they had produced, and stated that he was communicating his great appreciation of this to G.H.Q. Baghdad. The Russian staff was at this time again making arrangements to retire, as the situation in Russia, and lack of funds, made the position in Persia untenable, and the men were more than ever out of hand.

Return to Baghdad.

Attempts were made to get in touch with the Wali of Pusht-i-Kūh to obtain permission for the party to pass through his territory and survey *en route*, but no reply could be obtained, and on 15th December further orders arrived from G.H.Q. Baghdad that the survey party was to return with the Anzac wireless section via Qasr-i-Shīrīn. Colonel Kennion, who had arranged to proceed to Baghdad also, now made arrangements with the tribes whose country was to be entered. There were heavy falls of snow at the end of December. Final arrangements were completed, rations and transport obtained, and a start on the return journey made on 1st January 1918. Captain Perry was ordered to take command of both survey and wireless parties. The Chehār Zabar pass was crossed with great difficulty in a blinding snowstorm, and the very heavy wireless waggons on this day, and subsequently between Harūnābād and Karind in pouring rain, with the track a quagmire, had a terrible experience. It took eight hours to do twelve miles on the first occasion, and sixteen hours to march twenty miles on the latter day. A British column was sent up to meet the parties in the pass at Surkha Dīza in case of trouble. There was none however, and the survey party, reaching Baghdad on 16th January, went into billets in Karradah, the southern suburb of the city.

Here the party made combined traces of its work, which comprised in all about 4560 square miles on the ½-inch scale, for reproduction by the vandyke process, and wound up its affairs. On the 31st January 1918 the party was broken up, and its personnel was incorporated with the Mesopotamian organization under the Director of Surveys, M.E.F.

CHAPTER X

WEST AND NORTHWEST PERSIA

Effect of the Russian debacle in Asia.

THE energetic measures taken by the British in South Persia and the efforts of the Anglo-Russian "East Persian Cordon" had had most successful results in preventing the seeds of German intrigue from bearing fruit, so long as the Russians remained staunch. With the debacle of the Russians however, Germany had visions of a new line of advance, by Batum, Baku and Trans-Caspia.

Towards the end of 1917, preparations were made to send a German Army Corps to Baku. Turkish and Austrian drill sergeants crossed into Afghanistān. In remote Turkistān, the over-full Russian prison camps were opened by the Bolsheviks, and a horde of German, Austrian and Magyar prisoners, who had no means of livelihood except by fighting and plunder, was let loose. German emissaries of the "Kaiserliche und Königliche Ost-Indisches Abteilung", under the Bolshevik wing, laboured hard to organize these motley elements into battalions and brigades of some fighting value, and it became necessary to counter this effort by some form of screen protective to India.

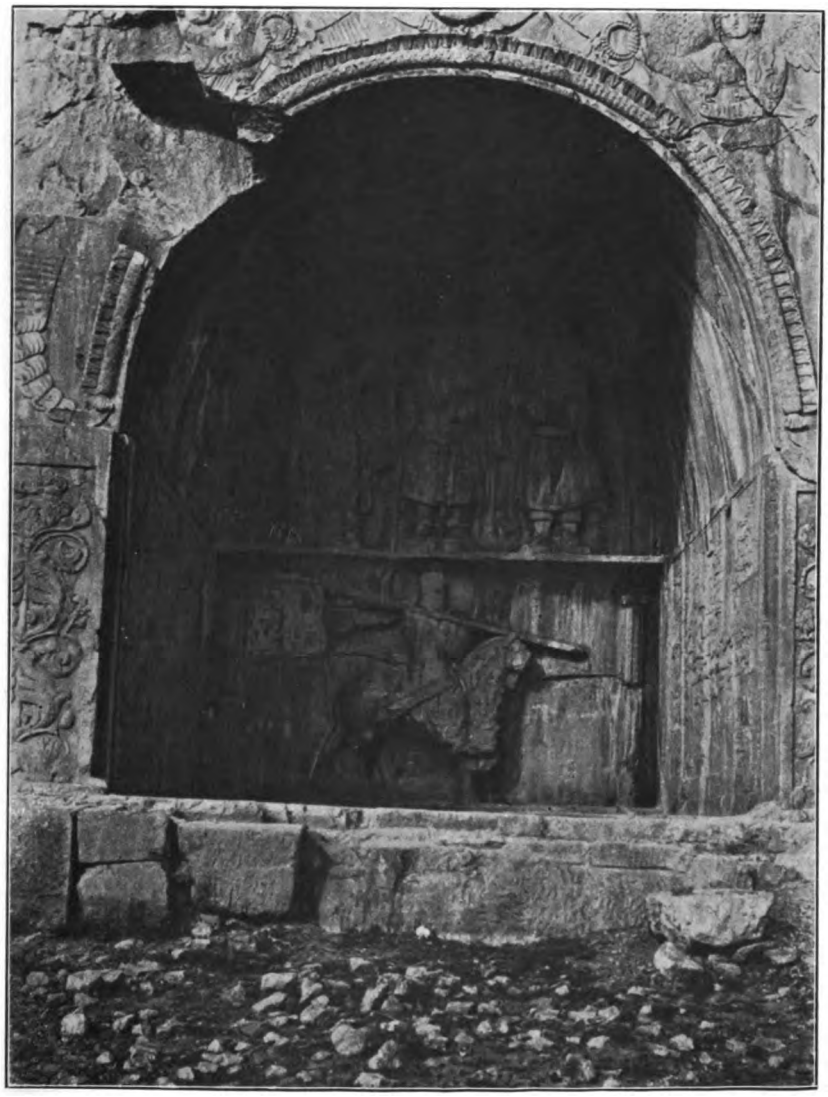
Despatch of the three Missions.

These measures took the form of three missions. The first under General Dunsterville made its arduous way to the Caspian shores, and helped to make history at Baku. The second under Sir Wilfrid Malleson pushed up along the deserts of the East Persian Cordon to Meshed, and in Trans-Caspia taught the half-trained Bolsheviks how to run; while the third, the tiniest mission of all, under Sir George Macartney, penetrated to Tashkent, and argued with the Bolshevik Commissary, "Sirul the Baker".

"Dunsterforce".

This chapter deals mainly with the survey work done in connection with the first of these missions. Preparations were made in December 1917 for the despatch of General Dunsterville's force. It left Baghdad towards the end of January 1918, about the time of the return of the survey detachment whose activities are described in the last chapter. It became necessary now to construct a road fit for mechanical transport upon which Dunsterforce must rely for supply. Towards the end of May, this road had been rendered passable for wheeled transport, and troops were sent through western Persia to garrison Kirmānshāh, Hamadān, and Kazvin. General Dunsterville himself entered the latter place on the 1st June 1918. A week later the remnants of the Russian

PLATE 22.



BAS-RELIEFS AT TAK-I-BOSTAN.

[to face page 76]

forces left Kazvin for Enzali, the Caspian port; they were ineffectively opposed at Manjīl, by the Jangalis, an outlawed Persian tribe, led by German officers. British troops now occupied Rasht and Enzali, while to safeguard the L. of C. back to Baghdad, support against the pro-enemy sections of the Sinjābis was given to the Gurān confederation of Kurds; the other sections of the line being protected on the principle, "Set a thief to catch a thief".

These events led to an extension of survey activities into western Persia. It was most desirable to connect Captain Perry's work with that of Mesopotamia, and also to construct an accurate map of the newly occupied areas, wherein operations might take place at any time.

N.W. Persia Survey Detachment formed.

A detachment was therefore formed by the Deputy Director of Surveys at Baghdad, and put under the charge of Lieut. D. K. Rennick, who was recalled from Hillah, on the Euphrates. This officer left Baghdad for Persia on 20th May, and reached Pā-i-Tak the following day. After experiencing great difficulty in getting his Ford cars over the Tak-i-Gireh pass on the 22nd May, he pushed on to Kirmānshāh. The condition of the people along the road was awful. They were at the end of a terrible winter, and thousands had died of starvation; the survivors were merely living skeletons. In Kirmānshāh itself, the richer Persians did nothing to help their hapless countrymen, and people lay dying in the streets. It seems incredible, but it is a fact, that human flesh could be purchased at one time in the bazars of the town, and it is recorded that in Hamadān two women were stoned to death for hawking dead babies. This situation was relieved as far as possible by the staff of Dunsterforce, who opened relief centres.

Lieut. Rennick made his own arrangements at Kirmānshāh with Colonel Kennion, the British Consul, and with the local military staff of General Dunsterville's L. of C. Permission from the latter to move from the main roads was difficult to obtain. Tribal escorts were therefore employed, but they were lazy, and, for stiff hill climbing away from the roads, most unsatisfactory. Often for his triangulation and detail suveys, Lieut. Rennick had no option but to leave his escort behind and work alone. His series lay largely in the area of the Kakāwand tribe and towards Sahneh, where he received assistance from the Persian governor.

Major Rich assumes charge.

Meanwhile it had been decided that the scope of survey work had widened in western Persia to such an extent that the personnel should be increased and placed under the charge of a more senior officer Major E. T. Rich, R. E., was therefore ordered to take over control. He arrived at Kirmānshāh on the 23rd June, and from that date, the whole detachment became part of the Dunsterforce. The personnel now included Lieut. Rennick, Jemadar Laltan Khan, and surveyors Ali Akbar, Muhammad Akbar, Khushal Khan and Mir Abdullah, all of the Survey of India.

Programme

It was originally intended to carry out a quarter-inch survey of the country, but at the request of General Dunsterville it was arranged in the first place to survey along the following main routes, generally on a width of twenty miles:—

(*a*) Hamadān to Kazvin.
(*b*) Kazvin to Tabrīz via Zinjān.
(*c*) Hamadān to Zinjān, direct, via Bijār.
(*d*) Kazvin to Enzali.
(*e*) Tehrān to Hamadān, direct.
(*f*) Kazvin to Tehrān.

At the time of Major Rich's arrival at Kirmānshāh, Lieut. Rennick was extending his triangulation of the year before, towards Hamadān. He now undertook the survey up to a point halfway between Kirmānshāh and Hamadān, after working out the positions of sufficient triangulated points for the surveyors, the work to embrace an area twenty miles wide and the hills on each side of the road. Major Rich with one surveyor went on to Hamadān, where he was delayed ten days for lack of transport. He utilised the time in commencing the survey of the town and surrounding area on the 6-inch scale. He then proceeded to Kazvin, reaching it in the middle of July, when he was put on the strength of Dunsterforce.

Details of work.

Lieut. E. C. O'Sullivan, with Subadar Hamid Gul, and Jemadars Khitab Gul and Madad Husain, joined Major Rich from Baghdad at Kazvin towards the end of July. A base was measured here, and observations taken for latitude and azimuth to enable Lieut. O'Sullivan to triangulate from Kazvin towards Hamadān. The latter connected his work with Lieut. Rennick's series in the middle of August at Siahdahān, on the Kazvin-Hamadān road, about 20 miles from Kazvin. Lieut. Rennick then triangulated from Hamadān to Zinjān via Bijār, and Lieut. O'Sullivan towards Tabrīz via Zinjān. This was however interrupted by the Turkish advance from Tabrīz and was not completed till August 1919.

In August 1918 Major Rich with Subadar Hamid Gul was sent with the main body of Dunsterforce to Baku which was threatened by the Turkish advance from Tiflis. Large scale maps of Baku and the surrounding country were obtained, redrawn in English style, sunprinted and issued to the troops.

There were no large printing frames in the equipment, but some were obtained from the workmen's committee, then managing the oil-works. Besides Subadar Hamid Gul, the only assistants were two Polish ladies for the fair drawing, two Polish children who were taught sunprinting, and an old Russian woman who made the sensitized paper. Major Rich and Subadar Hamid Gul recrossed the Caspian Sea on the evacuation of the town.

In September, while Jemadar Khushal Khan was completing the large scale survey of Hamadān, Subadar Hamid Gul mapped the Kazvin-Zinjān road and Lieut. Rennick and Laltan Khan, the Bijār-Hamadān road, with the intention, if weather permitted, of moving to the Zinjān-Bijār road later. The triangulation of the last named was completed by the beginning of November, and Lieut. Rennick with Khushal Khan, and Laltan Khan, the last of whom had been sick, shortly left for Baghdad.

During the same time, Mir Abdullah and Muhammad Akbar were working under Major Rich's personal supervision from the high pass between Kazvin and Hamadān to the former place, and Lieut. O'Sullivan

was surveying the Hamadān—Zinjān road. Having completed this, the last-named took up the Kazvin—Tehrān triangulation, which he finished by the beginning of November. He now turned his energies to the Manjīl-Enzali section and completed the triangulation to the foothills near Rasht, where the flat and densely wooded nature of the country forced him to suspend theodolite observations. Towards the end of December he commenced a subtense bar traverse from Rasht to Enzali.

With most of these operations from September to December, it was a race against time, it being of the utmost importance to get the high sections completed before the winter snow checked the operations. By the end of 1918, the detachment had completed the following work :—

Triangulation :—

Lieut. Rennick. ... 400 linear miles.
Lieut. O'Sullivan. ... 400 linear miles.

Detail surveys :—

On the ½-inch scale along the main routes, generally on a width of 20 miles, ... 10, 500 square miles.
On the 6-inch scale, the survey of Hamadān town had been completed.

In the drawing office established at Kazvin, numerous drawings and blue prints of the field maps had been completed for Dunsterforce.

Connection with Mesopotamia.

In addition to this, the original triangulation of the Western Persian Party, described in the last chapter, had been connected through to that of Mesopotamia and the boundary work by Captain de Graaff Hunter. This officer had been working in Persian Kurdistān (Gurān Kurd area), north-east of Qasr-i-Shīrīn, from early in June till the end of August, though the country was in a very disturbed state throughout. An important link was thus effected.

The programme at the beginning of 1919 was :—

(a) Kazvin—Tehrān, ... Survey on a 10 miles width each side of the main road.
(b) Manjīl—Enzali, ... Survey on a 4 miles width owing to dense jungle.

Later the following items were added :—

(c) Zinjān—Tabrīz, ... } on a 10 miles width.
(d) Tehrān—Hamadān, direct, }
(e) Hamadān—Kangāvar, By an alternative route to the east, avoiding the Asādābād pass.
(f) Enzali—Astarā, ... Westwards and north-westwards along the Caspian sea coast, on a width of 4 miles.

All the above were completed by the autumn of 1919 except (d) from Tehrān to Hamadān, direct, which was abandoned for financial reasons, and part of (a) in the neighbourhood of Tehrān. This was delayed owing to political difficulties, but was finished by Subadar Hamid Gul in January 1920.

Details.

The Kazvin—Tehrān survey was completed in February, except the small area near Tehrān above mentioned. Lieut. O'Sullivan's traverse from Rasht to Enzali was also finished in the same month. Major Rich, who met Lieut. O'Sullivan at Enzali, ordered him to continue his subtense traverse along the shore of the Caspian from Enzali to Astarā. This was finished by the beginning of April, Lieut. O'Sullivan returning to Enzali by boat and proceeding to Zinjān to take up triangulation from here to Tabrīz. The detail survey of the Manjīl—Enzali road, and the Enzali—Astarā coast was commenced in February. Both of these districts lay in the country of the Jangalis and the work was delayed by the Jangali rebellion. They were both, however, finished in June, by which time Lieut. O'Sullivan had completed the triangulation of the Zinjān—Tabrīz section. The detail survey of this strip was therefore taken up and completed in November.

Junction with Russian triangulation.

In the Kazvin—Tabrīz series, Lieut. O'Sullivan fixed two points, Tabrīz peak No. 1 and Tabrīz peak No. 2, common to the Russian triangulation which emanated from the Caucasus.

A comparison of the dual fixings is now given:—

		Latitude.*	Longitude.†	Height.
Tabrīz peak No. 1.	O'S.	38° 9′ 26·″13	46° 22′ 14·″83	7805 ft.
	R.	38 9 12· 81	46 23 1· 19	7882
	Difference	+13· 32	−46· 36	−77
Tabrīz peak No. 2.	O'S.	38 13 39·6	46 19 14·2	7239
	R.	38 13 29·26	46 20 2·40	7329
	Difference	+10·34	−48·20	−90
Mean difference. O'S − R.		+11·″83	−47·″28	−84 ft. †

Lieut. O'Sullivan, after completing his triangulation at Tabrīz,

* O'Sullivan's values are in his field terms except as regards height: but these will become expressible in Fāo terms after the Persian triangulation has been compiled. The Russian longitudes which were expressed in terms of Ferro meridian (defined as 20° west of Paris Observatory, which is 2° 20′ 13·″95 East of Greenwich) have been diminished by 17° 39′ 46·″05.

† The Baghdad drawing office prior to this connection, had been applying a correction −62 feet to heights on Russian maps (2 versts = 1 inch): so that a further correction of −22 feet was applied. Subsequently this additional correction was modified to −17 feet in view of further information.

proceeded to Mīāneh and made arrangements for the detail survey to be carried out by Jemadars Ali Akbar and Khitab Gul. He then travelled to Enzali and fixed points for an air-photo survey of Enzali town.

Tiflis Drawing Office opened.

At the end of February 1919, Major Rich went to Tiflis to organize a drawing office for advanced G.H.Q., Black Sea Army. The Russian maps of the Caucasus had to be redrawn and transformed into English maps with conventional signs, names, scales, footnotes, &c., all altered to the British military style. After a month at Tiflis, Major Rich returned to Kazvin, and arranged to close the drawing office there, when the traces for vandyke printing of all the ½-inch Persian surveys had been completed, a matter of another month. He returned to Tiflis in April, and till he went on leave in September, his chief work was the superintendence of the office here. Nevertheless he still remained in administrative charge of the survey detachment in north-west Persia, visiting it in June at Tabrīz, where he measured a base with Lieut. O'Sullivan. He also visited Kars and Batum to report on and make sketches of the defences of those towns.

Organization of Tiflis drawing office.

The organization of the Tiflis drawing office was rather a case of making bricks without straw. Major Rich had only one ex-officer with very little experience of mapping, whilst his drawing equipment consisted of his own personal instruments, a paint box, and a few rolls of ferrotype blue printing paper. He had to search for more instruments in Tiflis and to get a printing frame made locally. In order to provide personnel, he at once enlisted six Russian ladies and one man, all of whom he had to teach the rudiments of drawing. Their progress was marvellous, for they were infomed that any one who could not trace a map neatly at the end of ten days would be dismissed. They were all able to do this by the end of the first week, except one, who had to be discharged. They also learned to transliterate Russian names into English by a regular system. By the end of the first month the ladies were all very satisfactory "draftsmen", good hand printers, and could transliterate names. In April and May the office establishment was gradually increased to twenty, the strength at which it remained till closed down in September 1919.

Outturn.

The outturn of this drawing office consisted of sixty maps on the scale of 5 versts to 1 inch; thirty-six maps on the scale of 2 versts to 1 inch of parts of Azarbāijān province of Persia; twentyone miscellaneous military maps compiled on various scales, and a number of sunprints for issue to the troops. Major Rich reported very highly on the way his drawing staff worked.

Major Rich went on leave to the United Kingdom via Constantinople in the middle of September 1919 and Lieut. O'Sullivan took over the work in north-west Persia. The latter was engaged in work for the North Persia Force at Kazvin till the 5th November, when he closed work in Persia, and returned to Baghdad in January 1920. Subadar Hamid Gul, who remained under the British Military Attaché at Tehrān

to complete some local surveys near the capital, reached Baghdad shortly afterwards.

The total area in north-west Persia surveyed by the detachment was approximately 24,800 square miles on a scale of ½-inch to one mile, of which 10,500 square miles were completed before the end of December 1918. Large scale surveys of Kazvin, Rasht, Enzali, and Kirmānshāh were carried out with the assistance of air photographs. In addition, a thousand linear miles of triangulation and a hundred linear miles of theodolite traverse were completed, along the main routes in Persia and the shore of the Caspian between Enzali and Astarā.

Major Rich's Reports.

When Major Rich sent in his report up to the end of December 1918, he drew attention to the good work done by Lieut. Rennick in the autumn of 1918. This officer had previously done well under Captain Perry in the Western Persia Party, and also in Mesopotamia. Major Rich also mentioned the signal bravery displayed by Subadar Laltan Khan in saving the lives of his khalasis when attacked by Kurds, for which he subsequently received the Indian Distinguished Service Medal. A most regrettable incident occurred in December 1918, when Jemadar Madad Husain was murdered by Persians near Zinjān just as he was leaving for Baghdad on completion of his work in Persia.

In his final report Major Rich mentioned the excellent work of Lieut. O'Sullivan, D.C.M., a point which was fully endorsed by this officer's previous record both as a soldier in the Great War and as a survey officer on the frontiers of India and in Mesopotamia. Between August 1918 and June 1919, Lieut. O'Sullivan carried out more than 8000 square miles of triangulation and 100 linear miles of theodolite subtense bar traverse, computing his work as he moved from place to place. He had almost to be forced to take a day's rest now and then, lest he should break down from overwork.

Pusht-i-Kūh survey and boundary work.

The work of two other detachments should be recorded before closing this chapter on surveys in Western Persia. Both, as in the case of that just described above, were offshoots from Baghdad. The first to be mentioned is the survey of the Pusht-i-Kūh country, in Luristān, and was directly administered by the Deputy Director of Surveys at Baghdad; while the second, the examination and reconstruction of the boundary pillars, was controlled through the Civil Commissioner.

Lieut. Strong in charge.

As has been mentioned in Chapter VII, it was finally settled to send a survey detachment under Lieut. Strong with the geologists of the A.P.O.C. into the Pusht-i-Kūh towards the end of March 1920. This detachment started work from Alī-al-Gharbi on 4th April and finished on the 29th June. There was the usual difficulty in locating the survey stations of observation near Alī-al-Gharbi, but after measuring a new base and observing for latitude and azimuth, Lieut. Strong connected his triangulation with the old work on the Tigris and extended it to the Persian foothills on the north. Mirage was very troublesome at that time of the year and observations therefore difficult; but the work eventually closed without appreciable error on the Harūnābād-Mandalī

triangulation.

Description of country.

The Pusht-i-Kūh is uninviting and desolate. The lower hills consist of the broken Jabal Hamrīn, about 1000 feet high, running from north-west to south-east, where water is scarce and bitter. Parallel valleys and higher ridges lie behind the outer hills, as far as the main limestone range of the Kabīr Kūh, the highest point of which, Kūh-i-Warzaran, is 9171 feet above sea-level. The lower hills are thinly covered with dwarf oak, but wooded areas become more numerous and denser towards the higher ground. Except in the Āb-i-Donan valley at the foot of the Kabīr Kūh there is little cultivation.

The Wali of the Pusht-i-Kūh, Ghulam Riza Khan, had two sons with him, Sardar Ghulam Shah Khan, the elder, and Yadullah Khan Asraf al Mulk, governors of the northern and southern provinces of the Pusht-i-Kūh respectively. Lieut. Strong interviewed them and found them all very polite, though they objected to the survey and oil exploration, and wanted to confine operations to the Dilurān plain where oil had already been located.

Supplies.

Throughout the course of the survey, the party had the greatest difficulty in obtaining supplies, and it was only through the great assistance given by the A.P.Os of Alī-al-Gharbi and Badrah, who sent them supplies from time to time, that they were able to carry on. At one time provisions were obtained from Kut-al-Amārah, but such a course became impossible owing to the political situation in Mesopotamia.

Outturn.

The area surveyed by Lieut. Strong and his section was 3500 square miles on the ½-inch scale. The transport mules came from Ahwāz, and were found admirably suited to the difficult country. There were no proper roads, and all the tracks were rough. There was very little grazing, and the mules were fed on imported barley.

The section reached Mandalī on 12th July 1920. Mesopotamia was again in a state of ferment. A week after it had left Naft Khānah, the A.P.O.C's oil well north of Mandalī was attacked, and the British employees were obliged to leave the locality.

Boundary disputes.

There was another matter that cropped up for settlement in 1919. This was the question of the boundary between Irāq and Persia. Though the demarcation was the last peaceful act done conjointly by Russians, Turks, and British in 1914, the disturbances of the Great War had greatly upset the settlement, and squabbles were occurring all along the frontier. The Civil Commissioner at Baghdad therefore arranged that a small mixed commission should be appointed to settle the various questions involved and to re-erect the broken pillars.

K.B. Sher Jang in charge.

Khan Bahadur Sher Jang, who had been on the original commission with Colonel Ryder, was available, and was now appointed to carry out the work on behalf of Irāq. Operations commenced on the 6th April 1920 at the little village of Kanibez on the Hulwān river, some seven miles east of Khāniqin, where there was a dispute on the location of pillars 51, 52,

and 53. The commission then worked southwards along the frontier, repairing the pillars as far as No. 22, on the Duwarij river, which was rebuilt on the 6th May. Afterwards the party left for Amārah where it took ship for Muhammarah. From here pillars Nos. 1 to 7 were re-erected: Nos. 8 to 21 were not examined.

Sher Jang then returned with the commission to Khāniqin to take up the work north of this point. Leaving here on 28th June, the pillars were examined and repaired as far as Halabja, which was reached on 6th July. There was much unrest in these parts owing to the Arab rising in Mesopotamia. Difficulty in getting assistance and supplies delayed the work, and it was not till 29th August that pillars 104, 105, and 106, just north of the Lesser Zāb, were re-erected. The country here was more rugged. North of the Vasna grazing grounds, at pillar 117, which was repaired on the 9th September, the boundary follows the inaccessible crest of the Kandil Dāgh, and there are no more pillars till the Guru-i-Shaikh pass east of Rowandūz is reached. Here owing to the disturbed state of affairs, the political officer of Kurdistān would not give permission for the commission to proceed, and the work therefore came to an end.

Conclusion.

The surveys in west and north-west Persia covered a very large area, and have led to a very great increase in geographical knowledge. In addition to the actual surveys, many Russian maps have become available and the details of these have since been incorporated where no surveys were possible by Indian surveyors.

CHAPTER XI

EAST AND NORTHEAST PERSIA

IN 1915, the activities of agents of the Central Powers made it necessary to strengthen the Indian outposts in Sīstān. This policy led to the formation, in cooperation with the Russians, of the East Persian Cordon. It was however, not till the breakdown of Russian discipline and the consequent abandonment of the northern section of the Cordon, that the responsibility of securing the whole of the eastern frontier of Persia fell on India. This led to the formation of the field force which watched the line from Sīstān to Meshed.

Effect of the Russian debacle in East Persia.

As time went on, the Bolsheviks, allied to the enemies of India, assisted the agents of the latter to penetrate Afghānistān, and the mission of Sir Wilfrid Malleson was formed to deal with the situation in Trans-Caspia.

A very large field for work was thus opened up to the Survey of India. The whole region of the Eastern Persian Cordon's activities, much of which had previously been in the Russian sphere of influence, was now accessible. Existing maps of the whole of East Persia were very elementary, and it became necessary to undertake the whole survey *ab initio*.

A large field for fresh survey.

The westernmost point connected at this time to regular Indian triangulation was the mountain, Kūh-i-Malik-Siāh, the junction point of British Baluchistān, Persia and Afghānistān. More than once Indian geodesists have dreamed of a link diagonally across Persia from Kūh-i-Malik-Siāh to Mount Ararat, where Persia, Russia and Turkey meet. But political difficulties, no less than physical ones,—drought, heat, and flatness—have so far made such a connection impossible.

It is a matter for regret that work did not begin in East Persia earlier. Had this been the case it would have been possible to have had a series connected through to the mountains of the Russo-Persian frontier before the outbreak of the Third Afghan War. Extensions could then have been made to Merv and Krasnovodsk; and it might have been possible to carry out a junction between east and west Persia, and so link up the systems of India and Mesopotamia. As it was, orders were not received until the 11th September 1918 for the formation of a survey party at Mussoorie. This, under Lieut.-Col. H.L. Crosthwait, R.E., comprised Lieuts. P.A.T. Kenny, E.B. West, L. Williams, G.E.R. Cooper and F.J. Grice, of the Provincial Service; Jemadars Muhammad Husain Khan, Muhammad Husain, Shib Lal, and Afraz Gul Khan of the Upper Subordinate Service; and twenty-six surveyors and two computers of the Lower Subordinate Service.

It was realized from the first that time was going to be one of the main factors of the situation. The programme for this strong party was very large and included the triangulation and survey of East Persia within the following limits:—On the south from Nasratābād along latitude 31° as far as Sar-i-Jangal; on the west from the latter place along the meridian 57° 30′ to latitude 35° 20′; then through Turshīz to Turbat-i-Haidarī and down to Namaksar; and southwards along the Afghān boundary to Sīstān. This was subsequently modified to omit the portion of Sīstān which had previously been surveyed on the one-inch scale and also a portion in the south-west of the area, which lay in the Dasht-i-Lūt.

Programme.

The Lūt is the "manifestation in an extreme and concentrated form of the general aridity of Persia". At the best, a survey of it would entail the carriage of all supplies and water, great expense and small return. It was therefore wisely decided to omit this, unless an opportunity occurred later. As it was, from Kūh-i-Malik-Siāh northwards, the border of Afghānistān lies almost entirely in a desert country, waterless and very sparsely inhabited, until the Harī Rūd, which flows past Herāt, is reached.

The party left Mussoorie on the 3rd October and travelled by railway as far as Duzdap, some twenty miles south of Kūh-i-Malik Siāh. From here it proceeded by road to Bīrjand.

Survey by East Persia Party.

At this point the triangulation was commenced, a base being measured and a latitude observed. For the commencement of the work, a longitude was assumed, but a connection was subsequently made with the Kalāt Series at Kūh-i-Malik-Siāh and the whole reduced to Indian terms.

The programme was carried out on the half-inch scale and comprised altogether an area of some 42,000 square miles. Progress was rapid as the work could be carefully organized and there was no opposition; with the exception of certain areas on the Afghān boundary, from which the surveyors had to be withdrawn owing to the outbreak of the Afghān war, the programme was completed early in June; this comprised nearly 38,000 square miles. The party returned to India during this and the previous month, leaving behind a detachment to finish the programme and to extend the survey northwards along the motor road from Turbat-i-Haidarī to Meshed. A small detachment was also left at Quetta on the way back.*

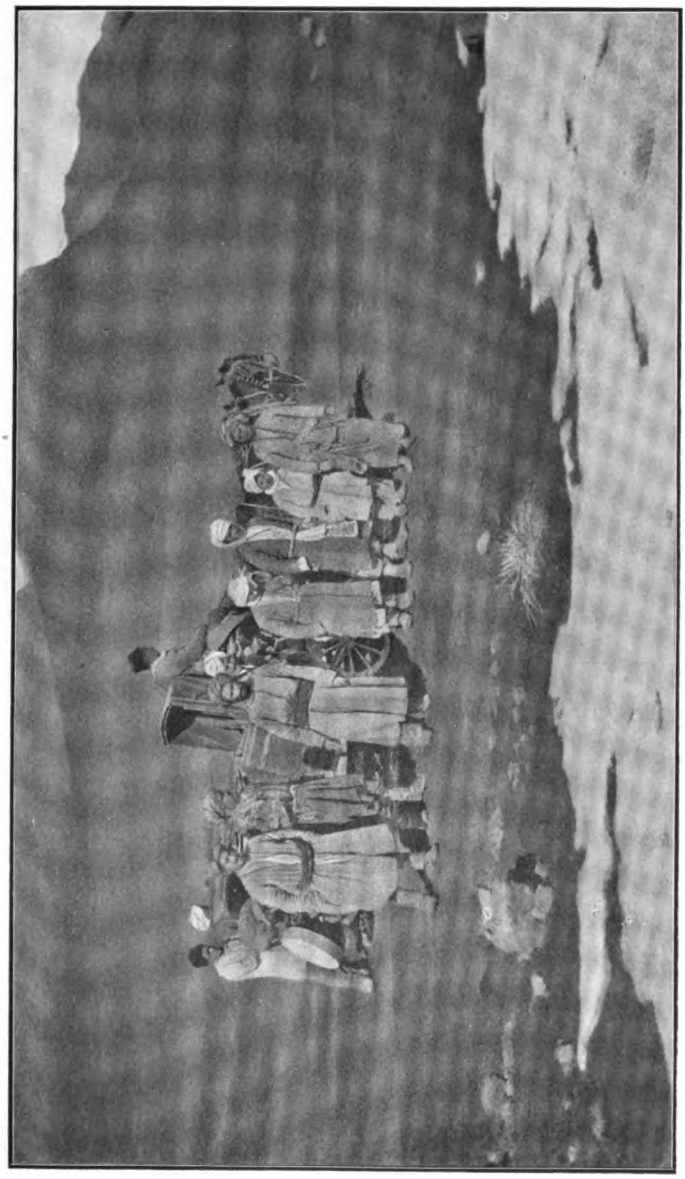
The detachment which remained in Persia consisted of Lieut. P.A.T. Kenny, Jemadar Afraz Gul Khan and three surveyors. The first named, however, was invalided before the end of May, and Lieut. L. Williams was recalled to Bīrjand to assume charge. He relieved Lieut. Kenny on 2nd June 1919, on which date the Bīrjand detachment was formed.

Bīrjand detachment formed.

It was intended during the summer that the detachment should take up the extension of the survey to Meshed. The area involved was about

* See Chapter XV.

PLATE 23.



THE SHŪTR GARDAN PASS, EAST PERSIA.

[to face page 86]

3000 square miles on either side of the road. But owing to the excessive heat, dust and haze, field work became absolutely impossible during the hot weather, and this part of the programme had to be suspended till the ensuing winter.

Meanwhile the detachment worked for the General Staff, turning out a large number of maps and plans, and carrying out a six-inch survey of Amīrābād encampment.

Towards the end of August, Lieut. Williams was also invalided, as were two of the three surveyors. Lieut. G.A. Norman was sent out with reliefs from Mussoorie, and took over charge on the 5th September.

Frontier reconnaissances.

Jemadar Afraz Gul Khan was transferred to Meshed on the 11th August to work under the G.O.C., Military Mission. He carried out several reconnaissances, north and north-east of Meshed, under Major L.V.S. Blacker of the Guides, and filled in many blanks in the map of the Kara Dāgh.

Meshed Extension

Lieut. Norman left Bīrjand for Turbat-i-Haidarī on the 15th September to take up the triangulation of the extension to Meshed. Observations were commenced ten days later. Simultaneously the detail survey was started, values of all stations and points being computed day by day and supplied to the three surveyors. The triangulation was completed by the end of October and covered an area of about 5000 square miles.

Kūchān Extension.

A further extension of this triangulation—known as the Meshed Extension Series—was then carried through to Kūchān, and covered an additional area of 5000 square miles. The more important points along the Russian frontier were fixed and a connection made to the Afghān Boundary Commission Survey of 1885. Points were also fixed on the Hazār Masjid Range for the military topographers and reconnoitrers in the frontier areas, who, with Afraz Gul Khan, were working under Major Blacker. These accomplished much good reconnaissance survey of the pioneer class, under substantial difficulties, due to the untrustworthiness of the local Persian authorities and the unsettled state of the border.

The whole triangulation and the detailed planetable survey—which latter involved an area of nearly 3000 square miles, and which covered a width of about 14 miles on either side of the motor road—were completed by the 20th December 1919.

For the next month, with the exception of Afraz Gul, who remained in the north with the Mission, the whole detachment was employed on the reproduction of important maps for the G.O.C. Meshed Force. A 12-inch survey of the new cantonment at Meshed was also taken in hand and finished. Afraz Gul remained throughout the summer carrying out and supervising several important reconnaissances round Bājgīrān.

Completion of original programme.

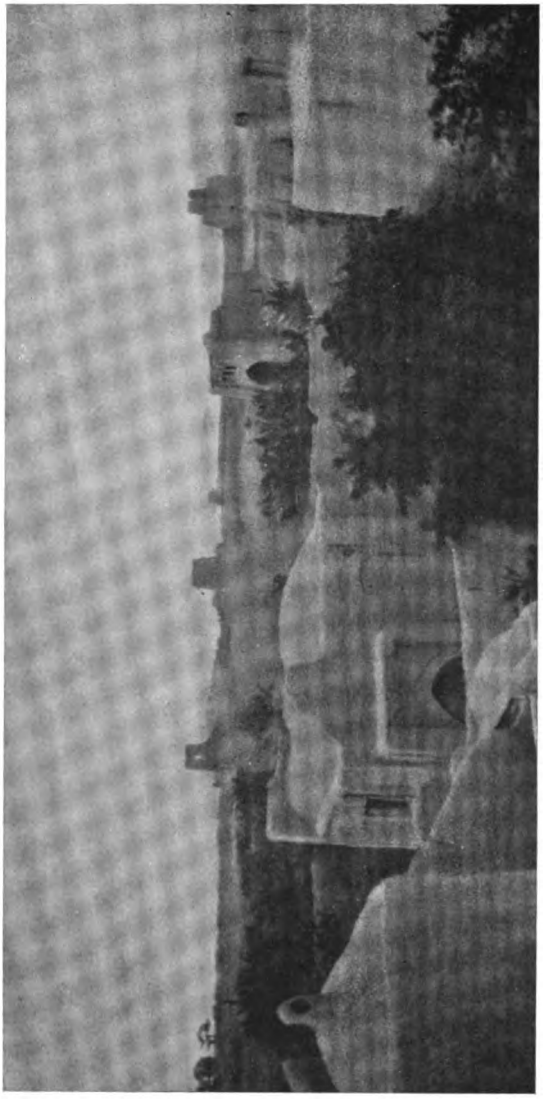
Early in February the rest of the detachment left Meshed by connecting convoy for Bīrjand en route for Sīstān, to complete the original programme of the East Persia Party, which had been left unfinished at the

outbreak of the Afghān war. The work here was begun on the 10th April 1920 from Bandān and completed in two months. The detachment then returned to Bīrjand, where orders were received, recalling it to India. A month afterwards it left for railhead, where on the 15th August it entrained for Mussoorie. Afraz Gul followed about a month later.

Outturn.

The total outturn of half-inch planetable survey accomplished by the Eastern Persia and the Bīrjand detachment was about 45,000 square miles, while the reconnaissances covered a further area of over 4000 square miles. Maps of the whole of this area were subsequently published on the quarter-inch scale in India.

PLATE 24.



RUI KHAF, EAST PERSIA.

[to face page 88]

PART III.—MISCELLANEOUS

PART III.—MISCELLANEOUS

CHAPTER XII

MACEDONIA

WHEN the British and French forces arrived at Salonika in November 1915, the only maps available for them were reproductions of the 1/200,000 Austrian staff map, and the 1/250,000 British compilation. The Austrian map was compiled from reconnaissance sketches along the main routes, and the British one was practically the same. These maps, though quite good of their class, were of little use for fighting purposes. As a matter of fact, the Greeks had started a survey after they took over Thessaly on the conclusion of the Balkan war in 1912, but the allied armies could get no copies of these maps till 1918, when it was found that the Bulgars and Germans had been in possession of copies all the time.

Pre-war maps.

In December, when the British and French troops fell back from Serbia, they took up a defensive position covering the town and port of Salonika, reaching from the Vardar river to Stavros, a position about fifty miles long, and about ten miles in depth. This position was vulgarly known as the "Birdcage".

Survey of the "Birdcage".

The French at once commenced a survey, on the 1/50,000 scale, on a rectangular projection, of the western part of this position, in which area their troops were located; and as soon as the British Ordnance Survey section arrived from Gallipoli, under the charge of Captain Meldrum of the Survey of Egypt, it started a similar survey of the eastern part, which was in occupation by the British.

The British survey section commenced its work by measuring a base about 500 yards long, and from this a series of triangulation was executed, which connected with the French. The origin of the latter and their coordinates of the junction points were adopted for the British work. This triangulation was not finally computed till about June 1916, and as very few planetables were available, the sheets covering the area were not completed systematically till 1917. Most of these sheets were filled in from sketches made by regimental officers with the divisions.

In June 1916 the allied troops advanced to the Greek boundary, which the Bulgar army had not then crossed, and the campaign settled down to position warfare, the British forces holding a line westwards from the mouth of the Struma, following roughly the Struma valley, Krusha Balkan hills, Doiran lake, to the Vardar river. The survey

Survey of forward areas.

section therefore extended its triangulation, running one series northwards from Salonika towards Doiran, then eastwards towards Seres, and a second chain northwards from Stavros to meet the first opposite Seres. Two check bases were measured for comparison but were not utilised in the computations; these did not disclose any large linear error, but the respective co-ordinates of the junction stations showed that there was a very considerable error in azimuth. The triangulation covered an area of about sixty miles by forty. The area was divided into sheets on the 1/50,000 scale, and others on 1/20,000 scale were laid out to include the fighting front. No steady programme of survey could be arranged to complete the sheets, owing to the small staff of planetablers being moved from one point to another by the general staff to meet immediate tactical requirements, and very little progress had been made in the topographical survey by December 1916.

Organization in 1916.

Throughout the year the survey section had been a separate unit from the mapping and reproduction sections. Each of these under comparatively junior officers, was working independently from the other under the general staff; most of the original survey work was of the nature of rapid reconnaissance, whilst many of the maps produced were compiled from enlargements of the 1/200,000 Austrian staff maps fitted in and corrected by intelligence reports and sketches as well as by work of the survey section.

Reorganization by Major Wood.

In December 1916, Major H. Wood R.E., Survey of India, who had been in command of the First Field Survey Company, R.E., in France, was sent to Salonika to introduce the methods of fixing enemy artillery positions, &c., which had been found so effective on the Western Front. He found, however, that the inaccuracy of the triangulation, the small extent of the area covered by maps, and the unsatisfactory quality of these, would make artillery fixation work impossible. Moreover, sound-ranging sections could not be spared from France at the time, and officers had therefore to be sent to France for training in sound-ranging and flash-spotting. The three sections, above mentioned, were amalgamated to form one company under Major Wood, who was allowed by the general staff to concentrate its entire energies on topographical work.

Revision of the triangulation.

Maps for artillery work must be of a very high order of accuracy, and the existing triangulation was in no way up to the necessary standard. The first necessity was, therefore, a revision of this triangulation. For this purpose a new base, about 6000 metres in length, was measured on the plain ten miles north of Salonika, with a Jäderin apparatus, borrowed from the French. Two measures were made, and the difference between them being negligible, the mean was adopted. Star observations for latitude and azimuth were made at one end of the base, and a network of large triangles covering the entire area occupied by the British force was laid out, as many as possible of the stations of the old triangulation being utilised. This new triangulation also connected with an old station at Salonika, fixed some fifty years or so earlier by the British Navy. As the longitude of this station was the only one known, and as the new

value of latitude for it differed very slightly from the naval one, it was decided to accept the original values of this station for the initial latitude and longitude of the new triangulation. The spherical co-ordinates of the stations of the new triangulation were converted to rectangular co-ordinates, using the French origin and the French value for the junction stations, and the whole of the old triangulation was then re-computed, but based on the sides common to the old and new work.

Planetabling.

Pari passu with this work, detail survey on scales of 1/20,000 and 1/50,000, on a plan accepted by the general staff, was carried out. But progress was not fast, as the surveyors who had formed part of the Gallipoli Expedition, were now worn out by exposure and the bad climate; and as it was difficult to obtain trained men from England, the Indian Government was asked by the Army Council early in 1917 to supply a survey detachment. In consequence, orders were issued by the Surveyor General on the 10th July 1917 for a survey detachment to proceed to Salonika under the charge of Lieut H. B. Simons. It was composed as follows:—

Lieut. H. B. Simons.
Subadar Jamna Prasad.
Surveyor Ghulam Rasul Khan.
" Ram Charan.
" Waidyanath Singh.
" Ganpath Sayaji.
" Mohkam Chand.
" Jagan Nathan.
" Muhammad Abdul Azim.
" Muhammad Mustafa.
42 khalasis (Hazāribāgh).

Arrival of Survey of India detachment.

These sailed from Bombay on the 28th July by H. M. T. *Akbar*, arriving at Suez on the 20th August, where they were held up for five weeks owing to a misunderstanding by G. H. Q. Cairo. On the 26th September, Alexandria was reached by train, and a further considerable delay occurred for lack of transport. Here one khalasi fell ill, and was subsequently invalided to India. The detachment eventually embarked at Alexandria on the 21st October, and on reaching Salonika three days later, was attached to the Field Survey Company.

Major Wood, commanding this company, had been on leave to England, but arrived back early in November, by which time the programme had been drawn up, transport arrangements made, surveyors and khalasis fitted out with warm clothing, instruments, and equipment, and all data relating to the work collected.

Programme.

On the 12th November, Lieut. Simons with nine surveyors and their khalasis, left for Kastri, the field head-quarters, and reached it on the 21st. From here, the surveyors were sent out to their respective areas and the following programme was taken in hand:—

(*a*) Lieut. Simons commenced the connection of the triangulation of the Field Survey Company with that done by the Navy;

at the same time fixing all observation posts, naval aiming lights, and conspicuous objects in enemy country for the direction of artillery fire, and for the compilation of sheets from air-photographs. This work comprised a total area of 720 square kilos (278 sq. miles).

(*b*) Seven surveyors were employed on the survey of the mouth of the Struma, comprising an area of 130 square kilos (50 sq. miles), on the scale of 1/20,000.

(*c*) Subadar Jamna Prasad, with surveyor Jagan Nathan as recorder, took up the triangulation of an area of 560 square kilos (216 sq. miles).

Air-photo survey of enemy country.

In addition to the regular survey of the area within the British lines, maps were naturally demanded of the ground occupied by the enemy. For this purpose air-photography was extensively employed and maps of practically the entire enemy position were prepared on a scale of 1/20,000. The topography of this area was controlled by an extensive system of intersected points fixed by triangulation from the stations of the network. Satisfactory approximate contours were drawn by viewing the overlap of the air-photos stereoscopically.

Severe winter weather.

Throughout November, December and January, the work of surveyors and aeroplanes was much interrupted by severe snowstorms and bad weather generally. The former, as their field work was completed, returned to the company headquarters at Salonika, and were employed on fair mapping and computations.

Map reproduction.

All maps were fair drawn here and reproduced in four colours, at first on a hand-driven flat-bed litho press, and later by a power-driven press obtained from England. A photo-reproducing camera had been early indented for; but as this did not arrive till 1919, after the close of the operations, it was never used. Separate tracings were meanwhile made for each colour and vandykes made from these.

On the 26th January 1918, the topographical programme outlined above was finished and the field headquarters of the detachment was moved to Aivatli on the Salonika - Seres road, which place was reached on the 31st January 1918.

Further programme.

A further programme was now undertaken, Lieut. Simons dealing with the general supervision of the section and the fixing of additional points, while Subadar Jamna Prasad and eight surveyors undertook the survey of 1620 square kilos (625 sq. miles). This programme was never completed.

Artillery observation and fixation.

Early in 1918 triangulation was sufficiently advanced to provide accurate bases for artillery fixation methods and the survey company was re-organized as the 8th Field Survey Company R.E., Two sound-ranging sections and an observation group arrived from France, and the flash-spotting organization of the heavy artillery was absorbed by the new unit. Lieut.-Colonel Wood remained in command and Major Phillimore

R.E., also of the Survey of India, from France, was posted to the company, taking charge of the artillery work of the unit. This was at first confined to the Doiran front, about twenty miles in length. As further officers and men were trained, the area of operations was extended to west of the Vardar river and it was only the cessation of hostilities in September 1918 which prevented this work from covering the whole position occupied by the British. In addition, from early in 1917 till September 1918, one officer and several N.C.Os of the company were continuously employed in fixing battery positions of the British artillery and preparing "battery boards" for each position.

Contouring maps of enemy country

In May, Col. Wood proposed attempting to contour the maps of the enemy country, on the Doiran front, from the British lines. These maps had been compiled from air-photographs and contained only such detail as was easily recognised on a photograph, such as streams, roads, villages, &c. For this experimental survey, Jemadars Ghulam Rasul and Abdul Azim were relieved from their normal topographical duties, and came directly under Colonel Wood. They did very good work and obtained such excellent results, that they remained at this class of work till August, under Major Phillimore. Their services were eventually acknowledged by the award of the Indian Distinguished Service Medal to each. Much credit is due to them and to their khalasis, who showed great gallantry and devotion to duty under continual heavy shell fire.

Proposed survey of Mt. Olympus.

At the end of August, Colonel Wood arranged for two surveyors to accompany him on the survey of Mount Olympus in October. Subadar Jamna Prasad, after completing the work he had in hand, was sent to fix points along the main ridge. The programme however fell through, for on the 10th September, orders were received to form a mobile survey section to follow the army, should the Serbo-Yugo-Slav offensive develop. In anticipation of further developments, Lieut. Simons, Subadar Jamna Prasad and five surveyors moved up to Yanis, which was reached on 20th September, the remaining two surveyors being attached to the 8th Field Survey Company to assist in drawing. Four days later, information was received to the effect that the Bulgars were retreating, and the section moved forward and reached Valandovo in Serbia on the 28th September.

Rout of the Bulgars.

The retreat had now become a rout, and five surveyors were immediately ordered to follow up with a rapid survey on the scale of 1/50,000, as there was none north of this point. Meanwhile Subadar Jamna Prasad pushed forward, immediately behind the advancing army, mapping the Strumnitza valley on the scale of 1/100,000. A total area of 954 square kilometres (365 sq. miles) on these two scales was surveyed during this very exciting phase of the war in Macedonia, but the results obtained were never fully appreciated owing to the sudden collapse of Bulgaria and the signing of the armistice.

Immediately after the defeat of the Bulgars in September 1918, Major Phillimore took charge of the British and Indian topographical sections which carried the British system of triangulation and survey into

and beyond the area surveyed by the enemy. This triangulation emanated from near Lake Doiran and extended to the Strumnitza valley, and on it about 200 square miles of detail survey was effected. The enemy triangulation, which was based on a German series, emanating from the Austrian pre-war triangulation along the Adriatic, had been carried eastwards to the Black Sea. The co-ordinates of the sections along the front opposite to the British were eventually obtained from the Bulgars, and, as many of these stations had been occupied by both surveys, an effective junction was made between the two systems. The German rectangular co-ordinates of these stations, when converted into spherical co-ordinates, gave practically the same values as the British, and thus the maps based on them joined up with no sensible difference.

Survey after the Armistice.

On the acceptance of the terms of the armistice by the Bulgars, all further work was suspended, and the section returned to its old headquarters at Aivatli, arriving there on the 4th November.

On the 18th November 1918, reinforcements as detailed below arrived from India :—

Lieut. B.T. Wyatt.
*Surveyor Hakdad Khan.
" Ismail Khan.
" Muhammad Ali.
" A. Samson.
Draftsmen P.M. Nalaraju Nayadu.
" R. Mariadas.
" R. Mohan Ram.
28 Khalasis (Punjabis).

Influenza broke out in epidemic form towards the end of the month, and with the exception of two surveyors and four khalasis, every member of the original detachment went to hospital.

Early in December 1918, orders were received for the detachment to hold itself in readiness to proceed to Constantinople, to survey the Gallipoli peninsula. As practically all the original men were in hospital, and not likely to be fit for work for some months, Lieut. Wyatt and the reinforcements that came out with him were detailed for the work. This did not however materialise, as Major Phillimore, who had been sent to Constantinople to report on the state of the existing Turkish maps, found a new survey unnecessary.

Proposed survey of Gallipoli.

The reinforcements were employed in completing the unsurveyed portion of a sheet that had been left when the detachment was sent to Yanis, and re-surveying portions of old 1/50,000 sheets. In February, Lieut. Wyatt, with two surveyors, was sent to survey the agricultural farm at Yanis on a large scale, while the remainder of the detachment returned to the headquarters of the company at Salonika, and were employed on fair mapping until the company was demobilised.

Employment of reinforcements.

The health of the detachment, notwithstanding the extremes of heat

* Relative ranks of Jemadar or Havildar.

and cold, was very good till December 1918, when the virulent outbreak of influenza in Macedonia, sent so many of the detachment to hospital. It is to be much regretted that Jemadar Ram Charan and twelve khalasis succumbed from the effects of the disease, while Subadar Jamna Prasad, Jemadars Ghulam Rasul and Abdul Azim and nine khalasis were rendered unfit for further active duty and ordered back to India.

Health.

From a topographical point of view the country surveyed was comparatively easy. The plains and lake areas were never very intricate and were generally open. The hill country embraced a succession of parallel ranges running from north-west to south-east, and averaging from 1000 metres (3282 feet) to 2000 metres (6564 feet) in height, divided by long valleys from 3 to 5 kilometres (1.86 to 3.11 miles) broad. The ranges, with the exception of the Belasica Palanina are not precipitous, but rise gradually and are open or covered with scrub oak, while beech, chestnut and pine are encountered only towards the summits of the higher peaks.

Description of the country.

Survey work with the Salonika force was much hampered by the climate, and by the lack of transport, which, more particularly in the early days, was difficult to obtain. Extremes of heat and cold were met with, the thermometer in summer often registering 108° F. in the shade, while in the winter the temperature fell many degrees below zero. A peculiar high wind, known locally as the " Vardar " blew practically all the year round, and often assumed the intensity of a gale. The hardships experienced in the winter during the spell of the "Vardar" in its worst form were beyond expression; the initial stage was the signal for the suspension of work for several days at a time.

Climate.

The season may be divided as follows:—

(*a*) Spring, from the middle of March to the middle of April.

(*b*) Summer, from the middle of April to the end of September, during which months the days were extremely hot and dry, with frequent droughts of four and five weeks duration. Malaria was virulent at this season.

(*c*) Autumn, October and November, when the rains began.

(*d*) Winter, from December to March, when very little work could be done owing to continual rain and frequent violent blizzards.

During its stay in Macedonia, the Indian Survey detachment completed an area of 2,692 square kilos (1,039 sq. miles) of detail survey and 1,310 square kilos (506 sq. miles) of triangulation. This is exclusive of the mapping done by air photography.

Results.

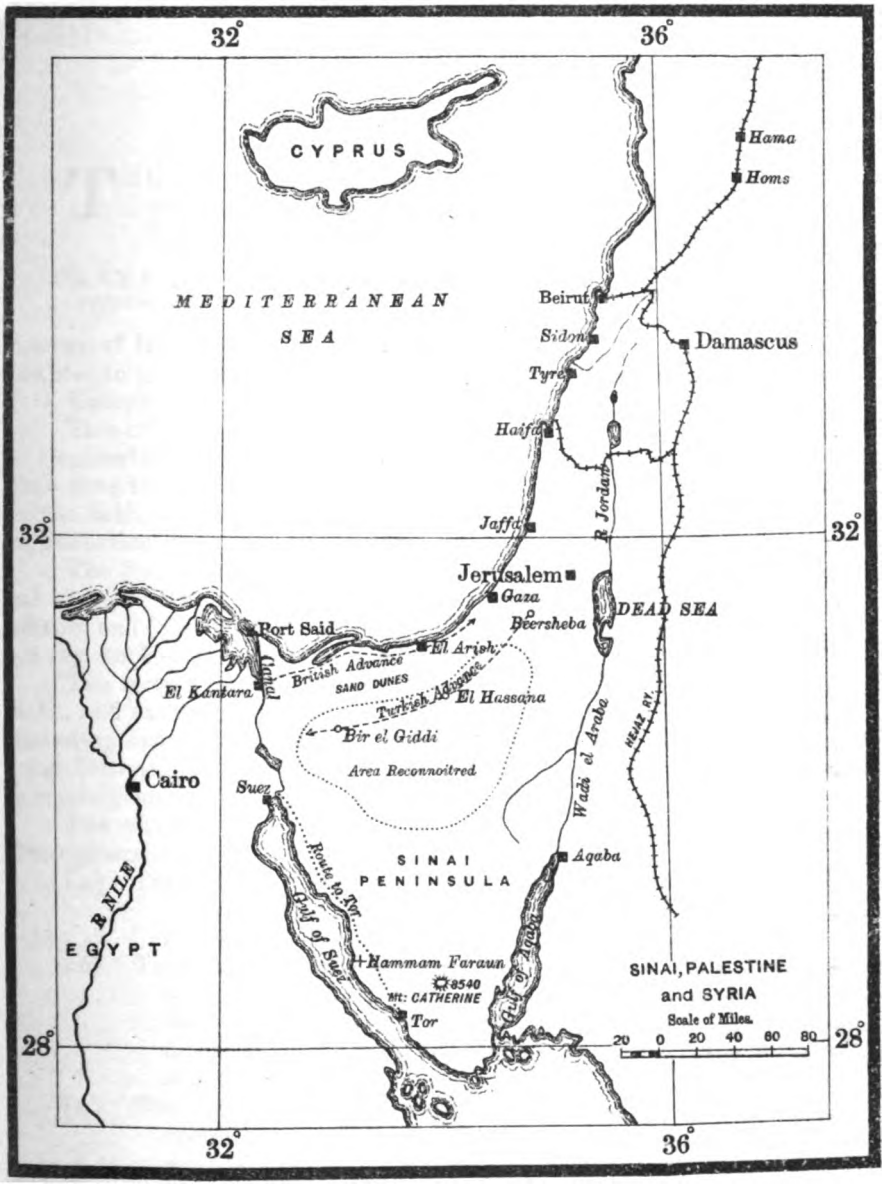
In March 1919, after all the material had been fair drawn, the unit was disbanded and the records sent to the War Office in London. Owing to lack of accommodation the Indian detachment returned to India in batches, the last arriving under Lieut. Wyatt on 26th April 1919.

Conclusion.

In his despatch dated 1st December, 1918, General Sir George Milne, C.-in-C., British Salonika Force, wrote as follows:—

"The results of the labours of all branches of the Field Survey Company, Royal Engineers, have proved invaluable, and full advantage has been taken of the opportunity for obtaining accurate maps of Macedonia, in close co-operation with the French and Serbian Topographical Sections. This task, undertaken in addition to the numerous trench maps required on a front one hundred miles long, has thrown a considerable strain on the personnel of one company".

MAP IX



[to face page 98]

CHAPTER XIII

SINAI AND PALESTINE

THE Survey of India was not concerned from a departmental point of view with the geography of Sinai, Syria and Palestine. The mapping of these countries was supervised throughout by the Survey of Egypt, and the general history of the work will be, if it has not already been, recorded by that department. Nevertheless the Survey of India was indirectly concerned here, and it is proposed in this chapter to give a brief record of the work and reconnaissances of Major J.D. Campbell, R.E., Survey of India.

The E.E.F. Survey organization

This officer, who had been reverted to military duty, reached Egypt in September 1916 and was attached to the topographical section. At that time this section consisted of a few officers of the Survey of Egypt in the field, with an O.C. at Cairo, where A.H.Q. then was, and all map reproduction was done at the survey headquarters there.

The Survey of Egypt had no native personnel trained in topographical survey. To expand the unit, it was therefore necessary to employ officers and N.C.O's from all arms, who had some previous knowledge of survey work, and to give them additional training.

The section was later reorganized as the 7th Field Survey Company R.E., and expanded very considerably in the way described, ultimately including one flash-spotting, and two sound-ranging sections sent out from Europe. The former proved of little value, but the latter were extremely successful.

The campaign, from the survey point of view, may be divided into three phases.

(*a*) The defensive warfare on the Canal. During this period the army occupied a broad front and a narrow strip was surveyed along the defensive line.

(*b*) The advance along the coast to El Arish. Here the army was operating on a narrow front and the amount of work in the forward area was necessarily much reduced. Nevertheless much survey could be carried out along the lines of communication.

(*c*) The operations in Palestine. Here the army was again operating on a broad front, with correspondingly increased work in the advanced area.

The method of work adopted during the advance to El Arish, being new to the Survey of India, may be of interest. The country consisted of flat, or undulating sand desert with a maze of elevations and depressions

Methods of Work.

having no relation to each other and impossible to survey by the methods adopted in water-worn areas. To work by intersection was impossible, and the method adopted by the Survey of Egypt in such country seems to be the only feasible one where speed is essential. The instruments used were the planetable, Indian pattern clinometer, and a telescopic alidade and tacheometer combined. Surveyors and staff-holders were mounted on camels. There were from three to four staff-holders and a head man who remained with the surveyor to carry flags of different colours with which to signal to the staff-holders. These latter were sent out in different directions, their movements being controlled by signal. By halting them at the tops of elevations, and the bottoms of depressions, fixing their positions with the tacheometer and determining heights with the clinometer, the ground could be accurately contoured within a considerable radius of the planetabler's position; and as the staff-holders could trot from point to point the work was rapid. The tacheometer measured distances up to 800 metres, so that, under suitable conditions, a considerable area could be surveyed from each fixing.

In the last phase, the work was divided into sections. When there was a forward movement, each section extended its own triangulation and carried out all surveys possible at the front. If the line was checked for long, the work was extended backward over the newly occupied territory.

Points were intersected as far as possible beyond the line as a basis for air survey. Palestine abounds in ruins, tombs, etc., situated on the hill-tops. It was therefore possible to fix a very large number of points as far as a distance of twenty miles. During the long period when the line was stabilised after the fall of Jerusalem a wide strip of enemy territory was thus mapped, and it was also possible to survey the greater part of the occupied territory behind the lines, all surveys being on the 1/40,000 scale.

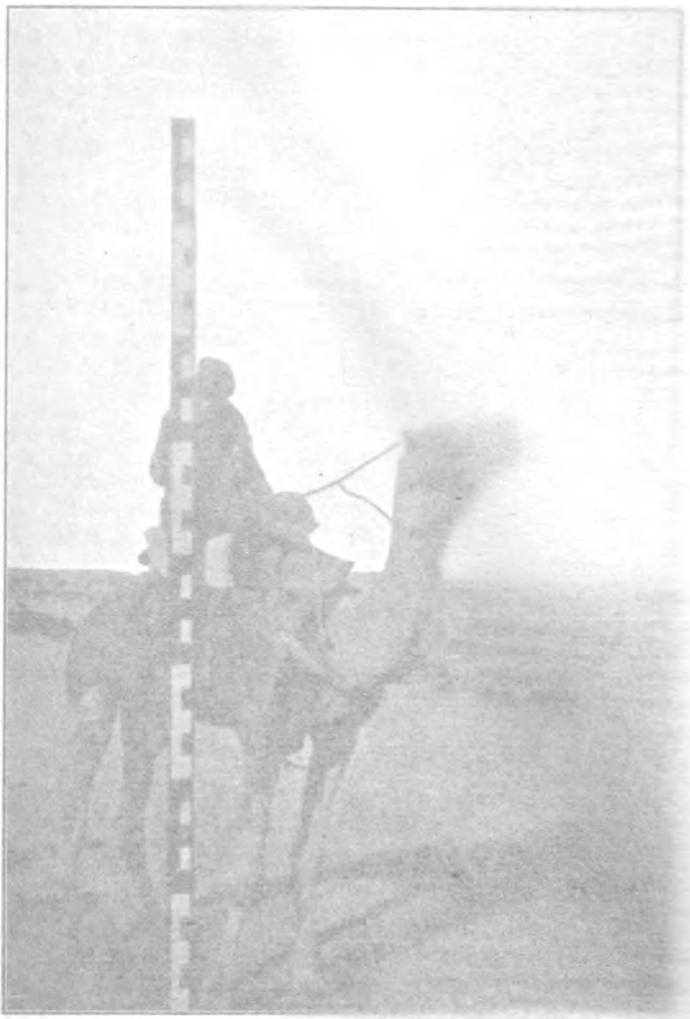
Major Campbell's relations with the Survey of Egypt were extremely cordial, and he has a great admiration for the way in which they tackled the problem of survey on this front, and evolved a unit which did a vast amount of valuable work.

Up till the fall of El Arish, Major Campbell was employed on the normal field duties of the company, and there is nothing special to record. Soon after that event however he was given charge of a reconnaissance into the interior of the Sinai peninsula, which had been evacuated by the Turks, owing to the British advance along the coast.

Gulf of Suez Reconnaissance.

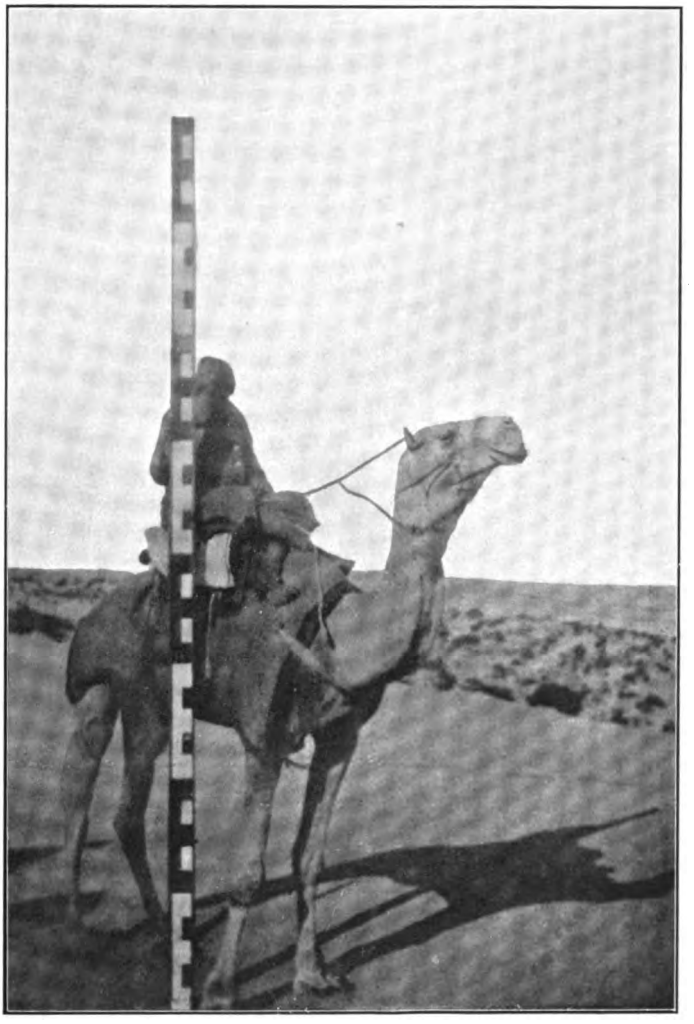
While arrangements were being completed for this, Major Campbell, in charge of a small survey detachment, accompanied a column of the Imperial Camel Corps along the coast of the Gulf of Suez to Tor, the quarantine station for pilgrims returning by sea to Egypt from Mecca, and held by an Indian garrison during the war.

One of the objects of this expedition was to get into touch with a tribe of local Arabs who had been giving trouble, but, as far as this objective was concerned, nothing was accomplished. The sight of a column of a hundred rifles with accompanying transport proved too much for the local gentry, and not a single inhabitant of any description



A Survey Staff-Bearer

PLATE 25.



A SURVEY STAFF-HOLDER IN SINAI.

[to face page 100]

could be found, during the whole trip.

The route followed is flat, but the mountains inland are rugged and fine, culminating in Mount Catherine of the Jebel Musa group, 8540 feet high, one of the traditional peaks identified with the biblical Mount Sinai.

Hammam Faraun.

At some points the hills come right down to the sea, the route being some miles inland. At one place the survey party was able to bathe under unique conditions in a mixture of hot sulphur and cool sea water, the former flowing from a spring a few yards from the sea shore. The spring, called Hammam Faraun, is at the foot of Jebel Faraun, the legend being that it is the opening down which Pharaoh went to hell after his pursuit of Moses. The whole country abounds in traditions, both Christian and Arab, in connection with Moses, and there is a large Christian monastery on Mount Catherine. No elaborate survey work was undertaken, the average daily march being fifteen miles, but a useful map and report were brought back of what was practically an unknown route, the former being based on peaks which had been previously intersected form the north.

Exploration of Sinai Peninsula.

Three months were spent on the exploration of the Sinai peninsula. From the military point of view the position in the interior of Sinai was rather a peculiar one. After their first dash to the Suez canal, the Turks had planned a campaign of a more permanent nature, involving a methodical advance and assisted by a railway, piped water line, etc., much on the lines of the ultimate British advance from the Suez canal. The coast route was denied to them owing to the British command of the sea, and they were therefore compelled to try the inland route which offered far greater difficulties in the way of water supply.

Between the coast and the Turkish line of advance was a belt of sand dunes, about thirty miles wide, almost impossible to traverse and affording complete protection to the flank of either army. After the fall of El Arish and the consequent evacuation of central Sinai, it was decided to make a thorough reconnaissance to discover everything possible about the Turkish dispositions and to report on all water supplies etc., in case of a later set-back. Information on these points was very meagre and it was only possible to send a force of sufficient size to overawe hostile Arabs on the assumption that no Turks would be encountered. This duty was allotted to Major Campbell assisted by two officers with an escort of fifty rifles.

Method of reconnaissance.

The reconnaissance was divided into two halves. For the first six weeks headquarters were established at Bir el Giddi, a group of wells about fifty miles east of the Suez canal, and for the second six weeks were moved further north to a point some fifty miles from El Arish. The escort during the first half was drawn from the Imperial Camel Corps, (raised from the Australian cavalry), and during the second half from the Bikanir Camel Corps.

The method of work was for each survey officer to set out with about twelve men as escort, and make a pre-arranged reconnaissance tour

of about ten days, all reassembling at headquarters at the end of each tour, when, after a day's rest, the process was repeated.

In this way complete reports were prepared on the whole of the Turkish works, new and old water supplies, routes, etc., and the necessary additions made to existing 1/250,000 scale maps.

Supplies were sent out by periodical convoys from the Suez canal and El Arish. Landing grounds were made at headquarters and aeroplanes paid frequent visits to see that all was well. A wireless set was installed, but this was not to be used except in an emergency for fear of giving things away to the Turks.

The work was somewhat strenuous, being carried out at the hottest time of year. Long distances were covered, Major Campbell himself riding 1600 miles on camel-back during this and the previous reconnaissance. Things were not made easier by the fact that, except on the rare occasions when drinking water was encountered, the water ration was limited strictly to one gallon a day per man. No Turks were met, though the reconnaissance was taken up to within a few miles of Beersheba where the Turkish left flank then was.

Aqaba artillery map.

On completion of the Sinai reconnaissance Major Campbell, assisted by a warrant officer from the Australian Survey, prepared a map of the country within about six miles radius of Aqaba, to be used by the monitor stationed at the port to shoot from in case of a Turkish counter-attack.

The voyage to Aqaba was accomplished with some difficulty in a boat belonging to the Egyptian coastguard service, and manned by Egyptian officers, none of whom had navigated these waters before. The chart was very indifferent, and the captain unwilling to proceed up the Gulf of Aqaba in the dark, but in the end all the troubles were overcome.

Aqaba.

Early in the war the Turks had entrenched Aqaba strongly against an attack from the sea, but Colonel Lawrence, arriving unexpectedly from the land side with his Arabs, had captured it. The Arab army which had held it ever since, was now under the command of Gafar Pasha, who, when in command of the Senussi, had been captured by the Dorset Yeomanry.

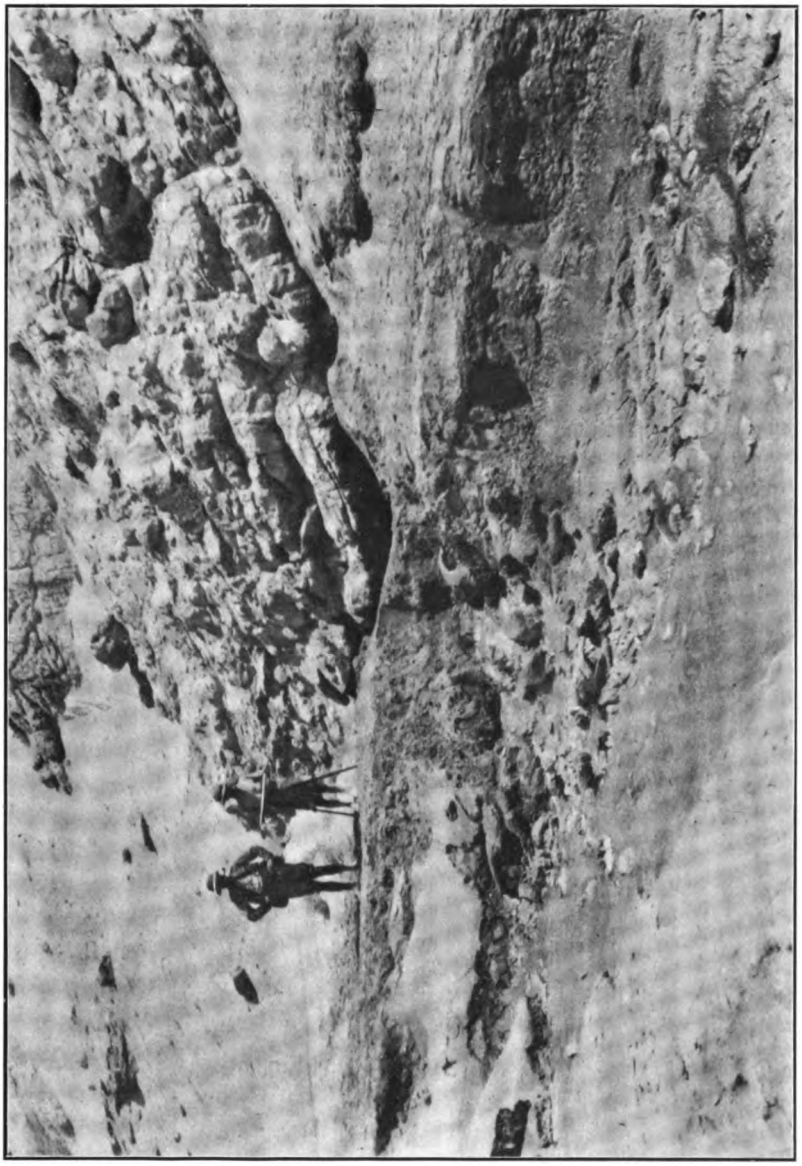
The military position was somewhat obscure. No one seemed to know anything except that somewhere in the interior an Arab army was in contact with the Turks. Hence the desire on the part of the Navy to have a good map to shoot from in case of a Turkish venture.

As a framework for the map a rough triangulation was carried out and connected with previously intersected points on the Sinai side. The position of the fort of Aqaba was then determined accurately for the first time. The map was prepared on the scale of 1/30,000.

Area surveyed near Aqaba.

The greater part of the area surveyed was in the Wadi el Araba, which forms part of the depression extending along the Jordan and the Dead Sea to the Gulf of Aqaba. The town of Aqaba is of great historical interest. Used by King Solomon as the port connecting Jerusalem with Africa, afterwards made a military post by the Romans, it formed

PLATE 26.



HAMMAM FARAUN.

[to face page 102]

during the war the base from which Colonel Lawrence carried out his periodical raids on the Hedjaz railway, and from which finally the Arab army, co-operating with General Allenby, advanced on Damascus. A curious feature of the place is that, while the Wadi el Araba is devoid of fresh water from the Dead Sea to the Gulf of Aqaba, an abundant supply of it is obtained at Aqaba from shallow wells within a few yards of the sea.

Capture of Jerusalem.

Major Campbell was able to rejoin his company in time to take part in the survey preliminaries for the capture of Jerusalem. During the counter-attack made by the Turks, in an endeavour to recapture the city, he spent the day on the top of the tower of the Russian Hospice on the mount of Olives, sharing it with a battery commander who was using it as an observation post. The tower being a station of the triangulation which had been brought forward from the Suez canal, Major Campbell occupied it at once and observed to forward points. It is doubtful whether triangulation has ever been attempted under more interesting, if distracting, conditions, the whole of the British artillery being concentrated on the Mount of Olives, and a bird's eye view being obtained of the battle in progress just below, towards the Jordan.

The battle front stabilised.

The battle front now became stabilised and remained so during the winter months of 1917-18. Major Campbell, assisted by three officers, was allotted a two-divisional front in the hilly country north of Jerusalem, and during the winter, surveys were carried out on the lines which have already been described. In the greater part of his particular area, there was a strip of about three miles of 'no man's land' between the opposing forces, so that forward points could be fixed by triangulation in comparative comfort. The survey of 'no man's land' was not quite so peaceful an undertaking. The British constantly patrolled the area and survey officers accompanied the patrols whenever necessary. The Turks kept more to their trenches, whence they had the unpleasant habit of opening fire from concealed machine gun posts. Fortunately a plane-table is too tempting a mark to be resisted for long, and the Turks had not the patience to wait for the planetabler to reach decisive range; or perhaps they did not know that the planetabler had been ordered to survey 'as far as possible'. This could only be ascertained by experiment. Hence no harm was done, though there were several regrettable panics among Egyptian chainmen resulting in the loss of instruments. On one such occasion a chainman, in order to lighten his load, threw away the whole contents of a haversack he was carrying, including Major Campbell's lunch.

Another officer lost an Indian pattern clinometer under somewhat similar circumstances. Later, when the ground had been occupied, he was planetabling when an Arab girl, seeing his clinometer, informed him that she had 'another one at home like that'. She then produced the very instrument he had lost.

As soon as everything possible had been done in the front line, officers were withdrawn, one only being left in each section to assist in fixing gun positions, and to do any odd survey jobs required. Eight

or nine officers were available to carry out the survey of occupied territory, and Major Campbell was in charge of this work.

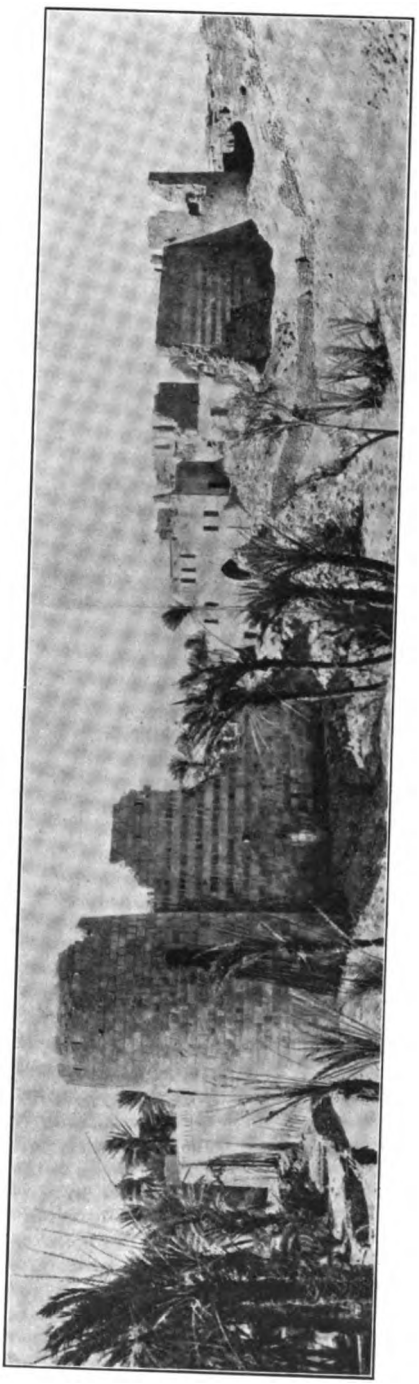
Survey of occupied territory.

At the time of the final advance Major Campbell was temporarily in command of the company. The arrangements for carrying forward the triangulation and survey from near Jerusalem to Damascus were made by him, but, owing to the collapse of the Turks and the signing of the Armistice, the work was not required for the military purposes of the campaign.

The final advance.

The triangulation was subsequently brought forward and a junction effected with Major Lewis's triangulation at Aleppo, as described in Chapter VI, but Major Campbell left for England before this part of the work was started.

PLATE 27.



AQABA FORT.

[to face page 104]

CHAPTER XIV

EAST AFRICA

State of maps in East Africa in 1914.

AT the outbreak of the war, the maps of the whole of East Africa were in a very elementary state. The Germans had produced small scale maps of their colony, and there was an indifferent map of Portuguese territory compiled by the *Companhia do Nyasa* from travellers' routes and reconnaissance reports. Even of the area near the coast there were no reliable maps, and places were liable to be as much as twenty-five miles out of their true position in longitude.

No. 6 Topo Section.

Up to 1918, military sketches were made by No. 6 Topo Section, R. E., under War Office arrangements, but the rapidity of Von Lettow's movements prevented any systematic survey from being carried out. In this year reinforcements were asked for from the Home authorities, but owing to the demand for trained surveyors on more vital fronts, they were not forthcoming from England, and India was asked to provide a survey detachment. This led to the mistake of sending Indian survey khalasis to East Africa on high wages, whereas local labour was obtainable at a much lower rate.

Personnel of East African detachment.

The East African Survey detachment under Lieut. A. J. A. Drake, (Indian Army Reserve), Extra-Assistant Superintendent, Survey of India, sailed from Bombay on the hired transport *Palamcottah* on 28th June 1918 and disembarked at Dar-es-Salaam on 12th July. It was composed as follows:—

Subadar Ram Pershad.
Jemadar Tara Singh.
" Amrit Ram.
" Singhbir Thapa.
Havildar Mhd. Yusuf Khan.
" Hari Datta.

Arrival at Dar-es-Salaam.

On arrival at Dar-es-Salaam, Lieut. Drake visited the Chief Engineer and received orders to report to the O.C. No. 6 Topo Section, to which unit the Indian survey detachment was attached for duty. The question was immediately raised as to the advisability or otherwise of retaining the Indian survey khalasis, but it was subsequently decided to do so. Owing to lack of shipping the detachment did not leave Dar-es-Salaam for Force Headquarters, at that time in Portuguese East Africa, until 12th August. At this time Von Lettow was in the Quilimane province preparing to raid Nyasaland. The British forces were being

split up into several columns with the intention of keeping him on the move and intercepting him if possible.

Transport difficulties.

At railhead Lieut. Drake ascertained that transport difficulties would be considerable. Only three Ford cars were placed at the disposal of the Indian Survey detachment and as the khalasis would have to carry their own kits and rations, a fact which would render them almost useless for their normal duties, Lieut. Drake wired to Dar-es-Salaam suggesting that they should be withdrawn. This was agreed upon and they subsequently embarked for India on 20th October.

Lieut. Drake assumes charge of the section.

Lieut. Drake then pushed on to Force Headquarters which was 75 miles from railhead and took over charge of the Topo Section from 2nd Lieut. McEwen, R. E., who was under orders to return to Dar-es-Salaam. This order was subsequently cancelled. Lieut. Drake therefore had with him one British officer, two sergeants and two sappers, besides the Indian surveyors. Hitherto a field litho press had accompanied the Force Headquarters but it was now decided to withdraw it, and utilise the sun-printing process for map reproduction. There were at that time four topographers belonging to No. 6 Topo Section in the field, and as Lieut. Drake had been sent for the express purpose of relieving them he arranged to do so as soon as possible.

Route surveys of Amrit Ram and Singhbir Thapa.

Jemadars Amrit Ram and Singhbir Thapa left Force Headquarters on 4th September to join a column marching to Port Amelia. On the way they carried out a compass traverse on the half-inch scale from Malema via Ribawe to Mkuburi in Mozambique province, a distance of about 116 miles, and from Namano to Medo, 40 miles, in the Company's district.

As far as Ribawe there was a road passable for motors, but the country was broken and covered with bush and long grass, which prevented the country on either side of the road from being surveyed in much depth. The crest of the Sierra de Inago was sketched however and several isolated hills put in. From Ribawe to Mkuburi, the track was only a bridle path, but the country was of the same character as before. The brigade-major of the force subsequently reported that the surveyors had carried out all work given them in a satisfactory manner.

Route surveys of Ram Pershad and Hari Datta.

Subadar Ram Pershad and Havildar Hari Datta left Force Headquarters on 12th September to join another column, but owing to a breakdown of the cars they reached their destination to find that the column had already marched. The columns were now moving rapidly owing to the German defeat at Loma and to Von Lettow's new attempt to break back into German East Africa. It was therefore impossible for these two surveyors to catch up the column without mechanical transport, and this was not available. Lieut. Drake had previously given instructions to them to traverse certain portions of their proposed line of march. They accordingly followed along the route which the column had taken, completing 302 miles of road traverse before they eventually reached the column on 18th October. The track was not marked on any map previ-

ously, and the rapid work of these two surveyors, practically alone, was a very creditable performance. The route lay first west and then northwards to the Lurio river. Here the Company's boundary was crossed. This traverse closed in the neighbourhood of Mahua.

A break of some seventy miles occurred at this point, the traverse work being again taken up at Lusenji Post and carried on from here to the Lujenda river, where the bush and grass gave place to denser forest. After reaching the Chulesi river, direction was changed to north-east, and the traverse finally closed at Ngomani on the Rovuma.

There was no other column to which the two remaining surveyors could be attached, so they were retained at Force Headquarters to assist in sun-printing and the preparation of traces.

New map of Portuguese East Africa compiled.

Headquarters moved on 16th September, but as the Indian Survey Section was then engaged in the compilation of a new map of Portuguese East Africa, which was wanted as early as possible, the section remained behind for five days. From then onwards, the time of the section was spent in travelling long distances by car. At last, owing to a new move of the Germans and a re-arrangement of the British forces, orders were received to proceed to Dar-es-Salaam. Lieut. Drake reached this place on 21st October, and was informed that a scheme for the reduction of No. 6 Topo Section had been sanctioned, providing for the return of the Indian detachment on the first opportunity. The surveyors attached to columns were recalled to Dar-es-Salaam, the last of them arriving at that place on 9th November. The detachment embarked on the Transport *Kara Deniz* on 21st December and reached Bombay on New Year's Eve.

The following is a statement of the route traverses carried out by the East African Survey Detachment :—

Name	Month	Miles traversed	Miles marched
Subadar Ram Pershad	September	135	135
Havildar Hari Datta	October	167	231
Jemadar Singhbir Thapa Jemadar Amrit Ram	September	156	354

General observations.

Although the military operations in East Africa were drawing to a close when the survey detachment arrived from India, the experience gained should be of value to the Survey of India if occasion should arise again to work in this theatre. There are, besides, several lessons to be learned by the brief experience of this detachment. Its raison d'etre was primarily military, and any hankerings it may have had for making a more permanent survey must have been dissipated at the outset. There were several reasons why nothing better than route traverses could be made. In the first place there were, as in Mesopotamia, no fixed points, on which to base a rigorous survey. But unlike the Turk,

the enemy in East Africa had limitless space over which to roam. When chased from one area, he could choose almost any point of the compass for his next raiding ground; he was not confined to the line of two rivers. Owing to the initiative and enterprise of the German commander too, the British columns were always in pursuit, and it was almost impossible to foresee in what area operations would next take place.

Conclusion.

Had the surveyor settled down to triangulation at any one point, he would have been hundreds of miles away from the area of which maps were required in a very short space of time. Furthermore East Africa was a backwater of the Great War. There were few facilities for wireless time signals and insufficient transport for the carriage of theodolites for astronomical observations. There were therefore no means of obtaining checks on traverses or for fixing points for an air survey, even had aeroplanes been available.

In operations in such a country in future, if rapidity and economy are essential factors, probably the most suitable method of survey will be to triangulate the open areas from measured bases, observed latitudes and wireless longitudes. The intermediate areas where forest or dense bush exist can then be connected by road traverses, and aircraft if available, can be utilised to photograph the details.

CHAPTER XV

NORTHWEST FRONTIER

Outbreak of Afghān War.

IT is not intended in this chapter to describe in detail the surveys that took place on the frontiers of India during the war. Such surveys and reconnaissances are in the nature of normal work and are usually arranged for by the Director, Northern Circle. Nevertheless the outbreak of the Afghān war was directly attributable to the unsettled conditions caused by the Great War, and a short reference to its effect on the Survey of India is necessary.

N. W. Frontier Party formed.

A North-west Frontier Survey party was formed and attached to the force operating on the Peshāwar front. It assembled at Peshāwar between 13th and 28th May 1919, and was composed as follows:—

Major H. McC. Cowie, R. E., in charge.
Bt. Major C. G. Lewis, R. E.
Lieut. R. C. Hanson.
„ B. T. Wyatt.
„ J. A. Calvert.
Mr. C. F. Oddy.
8 surveyors, &c.

Proposals.

In view of an advance to Jalālābād which, at that time, appeared to be a certainty, the party was at first organized in four sections, of which three were to accompany columns of the advancing force while the fourth section would, at first, be held in reserve at Peshāwar with the reproducing section. On the advance, the three sections were to establish themselves at Dakka, Basawal and Jalālābād and on the occupation of the latter place by the force, the reserve section was to move there also.

The campaign was brought to a close, however, without the advance being made, and, as operations took place over country which had been mapped already with considerable accuracy on the one-inch scale, the party had no opportunity of working over new ground. Except for about 88 square miles near the frontier north-west of Peshāwar, surveyed on the one-inch scale, the work of the party consisted mainly of large-scale plans of areas in which military works were contemplated or in progress.

Lieut. Calvert's section.

Soon after the occupation of Dakka, Lieut. Calvert with surveyors Sijawal Khan and Gujar Singh commenced a one-inch survey of the vicinity. The progress of the work was interrupted somewhat frequently, both by bad observing conditions and by the exigencies of the military

situation, and the area was not surveyed completely till about 1st August. This area included a small tract, previously unsurveyed, lying to the north of Darband village, but the extension of survey operations southwards over the valleys west of the Tsatsobi Kandao was not permitted.

Lieut. Calvert's section also completed a four-inch survey of the Khurd Khyber pass and its vicinity, and several large-scale plans of the Dakka camp area, before returning to Landi Khāna on 18th August to join Major Lewis' detachment which was attached to the Boundary Commission.

Miscellaneous surveys.

The principal works done by the remainder of the party were a four-inch survey of the roads through the Khyber and the Landi Khāna and Bāgh areas, and sixteen-inch surveys of Jamrūd, Alī Masjid and Landi Kotal, besides a two-inch survey of a strip along 14 miles of the Indo-Afghān boundary from Kāfirdara Sar lying to the south-east of Darband, to the Kābul river in the neighbourhood of Kam Dakka.

The detachment which, under Major Lewis, accompanied the Boundary Commission, assembled at Landi Khāna between 18th and 21st August and worked with the Commission until 7th September, by which time the whole of the boundary strip had been mapped on the two-inch scale, the boundary pillars built and their positions determined.

Of the work of the detachment, Major Lewis writes as follows:—

Afghān Boundary Commission.

"The Commission marched to Darband on the 23rd August. The original intention had been to visit the Tsatsobi Kandao on the following day and thereon place the southernmost pillar. But the road was found to be extremely difficult and further there was certainty of active opposition by tribesmen from Chinar near by. Since this portion of the boundary followed a well-defined watershed, actual demarcation was not essential, and Mr. Maffey accordingly decided to place the first pillar at some point on the main ridge east of Darband; this was done on the 24th August.

"On the 25th, the Commission returned to Landi Kotal by way of the Shamsa Kandao where three pillar sites were located and surveyed, the pillars being subsequently erected by the Sappers and Miners.

"On the 26th, the Commission, now joined by the Afghān general, Ghulam Nabi Khan and his party, erected pillars near the main road west of Tor Kham; and reassembling in the evening at Landi Kotal, proceeded the following day to Shāhnām Kalai in the Loe Shilmān valley, via the Inzari Kandao; and on the 28th to the hamlet of Shilmān Khwala Bānda near Kam Dakka on the Kābul river. During these two days Mr. Maffey located the line provisionally between Tor Kham and the Kābul River, but demarcation could not be proceeded with pending confirmation by the Government of India. The whole party returned to Landi Kotal on the 30th, halting for the night of 28th-29th at Yakha Chīna spring.

"On the 1st and 2nd September, pillars were erected north of Tor Kham and survey in this neighbourhood carried out, the survey of the whole area demarcated being then completed. By this time orders had

been received from Simla, and the Sappers and Miners, accompanied by the two surveyors returned on the 5th to complete the demarcation of the northern portion of the boundary, arriving back in Landi Kotal on the 7th."

Reproducing Section.

The Reproducing Section under Mr. Oddy arrived in Peshāwar on 2nd June with Vandyke equipment and one hand-power printing press capable of taking a 42″ × 32″ zinc plate. It was installed in the party office and commenced work at once by printing skeleton maps to illustrate reports. In a very short time demands began to flow in for printed copies of maps, plans and diagrams of a miscellaneous character, and up till the middle of September, when the "Norfront Force" broke up, the section was continuously at work at considerable pressure.

During the whole of the period over which the operations lasted, the conditions of life were trying; and Mr. Oddy, not in robust health when he arrived, had to be invalided about the middle of July. Under by no means favourable conditions he had succeeded in rapidly organising the section. After his departure, the charge of the section devolved on Babu Sadik Ali who proved himself capable and industrious. Besides satisfactorily managing the Reproducing Section, he gave much useful assistance in connection with the party's general affairs. After the conclusion of operations on 15th September 1919, the personnel of the party was gradually withdrawn from Peshāwar and disbanded.

Quetta Survey Detachment.

One other detachment was formed for work in connection with the Afghān war. As has been mentioned in Chapter XI, the officer in charge Eastern Persia Party received orders before leaving Bīrjand to arrange for survey work with the Baluchistān Field Force. In consequence, a detachment was formed at Quetta consisting of Lieut. F. J. Grice, Jemadar Shib Lal, and three surveyors, and joined the 4th Division at Chaman on the 18th June 1919.

Outturn.

The surveys enumerated below, besides much miscellaneous work, were done by this detachment, and ferro-type prints were supplied to the General Officer Commanding:—

Original surveys of:—

(*a*) Chaman Cantonment and bazar, scale 8 inches = 1 mile.
(*b*) About 20 square miles of country around Spīn Baldak.
(*c*) Spīn Baldak fort on the scale of 12 inches = 1 mile.
(*d*) Existing and proposed defences of Chaman.

On the signing of the peace with Afghānistān, the detachment returned to Mussoorie, reaching it on the 1st September 1919.

* * * * * * * *

Conclusion.

The writer of this volume has been tempted to record the work done by the Survey of India during the Wazīristān Campaign, 1919-20. But this would definitely begin a new phase of post-war activities, and at the end of its history, the same question of where to end would again crop up.

Throughout the volume, too, it has been a temptation to describe

survey systems in detail. This course would have entailed many technicalities of passing interest. For in particular, methods of air survey, and improvements of aeroplane cameras, have developed so rapidly, that any description would now be of little concern. Some of these methods were borrowed from France and other fronts, while much was developed *ab initio* during the compaigns described herein.

The volume is not a technical history of survey developments, nor a text book for future wars. Already the methods learnt have been put to practical tests both in frontier campaigns and in peace surveys in India, and much experience has been gained. The period from 1914-20 gave a great impetus to scientific survey; and it is the business of today to set experts to examine the new methods, to separate the good from the bad, and to develop the best on sound lines; so that when the next test comes, the Survey of India may be prepared to support the Army with the most up-to-date equipment that science can devise.

PERSONAL SERVICES OF OFFICERS ON THE SURVEY ROLL OF HONOUR

					Page
Captain	R. L. Almond, R.E.	killed in action	28th October	1914	115
„	H. M. McKay, R.E.	do	13th November	1914	116
Lieut.	V. D. B. Collins,	do	9th May	1915	117
Captain	E. B. Cardew, R.E.	do	25th September	1915	117
„	P. G. Huddleston, R.E.	do	25th March	1916	118
„	J. A. Field, R.E.	do	13th July	1916	119
„	G. F. T. Oakes, R.E.	do	15th July	1916	119
„	E. C. Baker, R.E.	died of wounds	19th September	1916	120
Brevet Major (temp. Lt.-Col.)	A. A. Chase, D.S.O., R.E.	do	11th March	1917	121
Captain	W. P. Hales, M.B.E., I.A R.O.	died	1st November	1918	122

CAPTAIN R. L. ALMOND, R.E.

Roland Latimer Almond, son of Dr. H. H. Almond of Loretto, was born on 13th January 1887 and educated at Loretto, Musselbrough. He entered the Royal Military Academy Woolwich in January 1906, and passed out first of his batch into the Royal Engineers two years later, gaining the Pollock Medal and Mathematical Prize. He was gazetted Second Lieutenant on 18th December 1907 and after two years at Chatham left for India. While in the Military Works services he was stationed at Rāwalpindi, Quetta, Loralai and Fort Sandeman and was employed chiefly on the construction and upkeep of roads. He was appointed to the Survey of India as an Assistant Superintendent on 21st December 1912. During his training at Dehra Dūn, he took a short spell of leave and with Lieut. H. McKay made an attempt to reach the summit of Bandar Pūnch.

In October 1913 Lieut. Almond joined No. 5 Party in the Southern Circle, with field headquarters at Chindwara and afterwards recessed at Bangalore where he was stationed at the outbreak of war. On 12th August 1914, he received orders to join the 3rd Sappers and Miners at Kirkee, and ten days later sailed with the 21st Company on the s/s. "*Taiyabi*"—an ancient and unclean pilgrim boat,—as part of the Lahore Division of Expeditionary Force 'A'. On arrival at Marseilles at the end of September, the division was rushed up to the front and came into action at Neuve Chapelle. In the fierce fighting of 28th October, the 20th and 21st Companies, Sappers and Miners, were employed as infantry, and suffered very heavy casualties, all their officers being killed, wounded or missing. Lieut. Almond was wounded while gallantly leading his men to the assault, and was subsequently reported 'wounded and missing'. He was afterwards gazetted Captain from 30th October.

Every effort was made to get news of him as a prisoner of war, and as the result of an advertisement in several French newspapers, a *poilu* wrote from Bordeaux in June 1915, that he had been in a German hospital at Bouin with Captain Almond. On personal examination, the man correctly picked out a photograph of Captain Almond from several others, insisting that he had been wounded in the leg and removed to Germany. Efforts were now concentrated on locating Bouin, but in vain, and the whole story was finally disproved entirely when in May 1916 the body of an R. E. Officer wearing a wrist-watch engraved with Almond's name and corps was found just outside Neuve Chapelle. Here he was buried, and here he remained till 1919, when his body was removed and reinterred at Chocques.

At school Almond was considered brilliant, and it was his father's wish that he should succeed him as headmaster of Loretto. Mathematics he delighted in, and he was a good linguist, being very proficient in French, German, and Hindustani, with some knowledge of Russian.

He enjoyed literature and had a keen ear for music. He was particularly fond of all outdoor games, being a very fine Rugby footballer. At Woolwich he captained the 'Shop' XV, and at Chatham he was honorary secretary to the club. While stationed at Chatham he captained a team which he took over to France, and he also 'stroked' a rowing crew of Rugby footballers which beat the R. E. eight on the Medway. In India he excelled at hockey, but all games seemed to 'come' to him easily. He had a passion for mountaineering, and he hoped for the day when his work in the Survey would take him into the heart of the Himalaya.

In the spring of 1914 Lieut. Almond took a brief spell of leave to England and married the daughter of Colonel F. Gosset, late R.E.

In connection with the action in which Almond was killed, the following is an extract from the despatch of Sir John French dated 20th November 1914: "On the 28th October especially, the 47th Sikhs and the 20th and 21st Companies of the Sappers and Miners distinguished themselves by their gallant conduct in the attack on Neuve Chapelle, losing heavily in officers and men". The Author of "*The Indian Corps in France*" writes of the same action: "The history of the Indian Army contains few nobler pages than that of the 28th October 1914". Almond was one of the first two Survey of India officers to be engaged in the Great War; he was the first to be killed in action.

CAPTAIN H. M. McKAY, R.E.

Henry Marshall McKay, the son of Colonel H. K. McKay, late I.M.S., was born on 6th December 1888 and was educated at Shirley House School, Old Charlton, and at Cheltenham College. After his two years at the Royal Military Academy, he was gazetted Second Lieutenant in the Royal Engineers on 29th July 1908, and posted to the Indian Establishment on 8th September 1910. He spent two years in the Military Works Services before joining the Survey of India as an Assistant Superintendent on 11th December 1912. He was stationed at Mussoorie on the outbreak of War, but was reverted to military duty during August 1914, and embarked for France at Bombay on the s/s. "*Elysia*" on 2nd September.

In France he was posted as an Assistant Field Engineer to the 3rd Lahore Division, and proceeded at once to the front. It appears that he was killed by a shell after delivering a message to a detachment of 34th Pioneers in an advanced trench on the 13th November, a fortnight after his promotion to the rank of Captain, and almost the first time he came under fire. He was alone at the time, and for this reason it has not been possible to obtain details of his death. It is sad to relate that his father's first intimation that his son was in France was a telegram recording his death in action.

The body was recovered by the 21st Company, Sappers and Miners, and buried in the garden of Madame Leroy Meaux on the left of the road from Sailly town, facing a flour mill at Sailly-le-Lys, alongside the grave of Major J. B. Corry, D.S.O., R.E., who had been killed the day

before. The body was afterwards removed and reinterred in the SE. corner of the garden of a house in Rue des Fufs (36 G. 22 b. 90.5).

Captain McKay had been in the Survey of India less than two years. But he had been in the department long enough to prove himself a keen and energetic surveyor. With the object of placing a survey pole on Bandar Pūnch, a snow peak visible from Mussoorie, he had taken leave with Lieut. Almond and attempted the difficult ascent, which was, however, unsuccessful through no fault of the two officers concerned.

LIEUTENANT V. D. B. COLLINS.

Vivian Donald Berry Collins was born on 10th January 1885, and joined the Survey of India as a Sub-Assistant Superintendent, 3rd grade, at Dehra Dūn on 1st November 1904. After serving in Berar with No. 2 Party and after being confirmed in the Department, he joined the Triangulation Party. With this he was employed on the Mawkmai series of triangulation in the Southern Shān States from 1908-1911, and in the summer of the latter year was in charge of the detachment sent to fix the position and height of Teram Kangri, a peak of the Karakoram range that had been reported to be of exceptional height. Mr. Collins carried out this triangulation with great energy, ascending sixteen peaks of over 19000 feet during the course of the expedition.

In the summers of 1912 and 1913 Mr. Collins was employed on the triangulation connection between India and Russia, holding charge of the detachment for a short period in 1912 after the death of Lieut. H.G. Bell, R.E. The section allotted to Mr. Collins was extremely difficult, as it lay along the gorge of the Hunza river, but he carried out his task successfully. On both these expeditions Mr. Collins proved himself a very capable and energetic triangulator and a courageous mountaineer.

During his periods of recess, Mr. Collins was an enthusiastic hockey player, being centre forward of a very fine Survey team in Poona. He always strove to keep himself fit and had a powerful frame.

On the outbreak of war, Mr. Collins was on leave in England. He at once enlisted, applying at the same time for a commission in the new armies which were then being raised. He was gazetted Second Lieutenant in the 13th (Service) Battalion, the Sherwood Foresters (Nottinghamshire and Derbyshire Regiment) on 17th December 1914, but was soon after transferred to the 2nd Battalion 2nd Gurkhas (Sirmoor Rifles) joining them in the Richebourg sector in France.

He was killed in action on the 9th May 1915, but his body was never recovered.

CAPTAIN E. B. CARDEW, R.E.

Edward Bellasis Cardew was born on 4th April 1883, and was gazetted Second Lieutenant in the Royal Engineers on 21st December 1901. Being posted to the Indian Establishment two years later, he served in the Military Works Services at Calcutta and Agra. He joined the Survey of India as an Assistant Superintendent 2nd grade on 3rd December 1906 and spent most of his survey service with the Triangu-

lation Party, being for a short time in charge of the Northwest Himalaya Primary series in 1909-10, and of the Upper Irrawaddy series in Upper Burma in 1910-11.

Lieut. Cardew was on deputation with the North Burma Mission from 1st October 1911 to 28th May 1912, and was in charge of the North Burma Mission Survey Detachment from 12th September 1912 to 9th May 1913, during which an area of some 10,000 square miles was explored and mapped in the Hkamti Long country.

Lieut. Cardew was promoted to the rank of Captain on 21st December 1912. He was on leave in Australia when the Great War broke out but was immediately recalled to India. On reversion to military duty on 22nd October 1914, he was sent to England and employed on Salisbury Plain in training recruits for the new armies. Captain Cardew crossed to France in July 1915 and went into action with the 73rd Field Company. On 25th September during the battle of Loos he led his men in the advance on Hill 70. He was seen to be wounded twice during the day and after the action was reported 'wounded and missing'. All efforts to trace his body were in vain. Captain Cardew was mentioned in Sir John French's despatch on 30th November 1915, for gallant and distinguished service in the field.

CAPTAIN P. G. HUDDLESTON, R.E.

Purefoy Gauntlett Huddleston was born at Cambridge on 28th April 1886. After being educated at Clifton College, which he entered in 1899, and at the Royal Military Academy, Woolwich, he was gazetted Second Lieutenant in the Royal Engineers on 16th January 1906. In February 1908 he was posted to the Indian Establishment and became Assistant Garrison Engineer at Fort William, Calcutta. He officiated as Garrison Engineer at Barrackpore and Darjeeling during the summer of 1908 and was appointed to the Survey of India, as Assistant Superintendent, 2nd grade, on 4th September 1909. He was stationed at Dehra Dūn, Simla and Shillong, was on deputation with the Abor Exploration Survey Detachment from 23rd October 1912 to 9th August 1913, and with the Akā Promenade on the borders of Bhutān for two months in the winter of 1913-14.

Lieut. Huddleston was very keen on his work and on outdoor sports. Besides being a good Rugby footballer, he was an excellent shot with both gun and rifle. He had the keen instincts of the explorer and had already before he joined the Survey made a successful journey up the Luhit river. When with the Abor Exploration Survey, he held charge of a section which explored the difficult Siom valley and its tributaries.

Lieut. Huddleston reverted to military duty on 22nd October 1914, was promoted Captain on 30th October, and on arrival in England was posted to the 84th Field Company, of the 20th Division, with which unit he proceeded to Flanders in August 1915. He soon rose to command his company, which he did with conspicuous success, but was unfortunately killed in action on the night of 25th March 1916, while his division was holding the salient north of Ypres, east of the canal.

A stone monument to his memory was erected by his comrades in the Ollivier Ferme Cemetery near Poperinghe.

CAPTAIN J. A. FIELD, R.E.

John Archibald Field was born on 2nd May 1884 at Sydney New South Wales, and began his education at Sydney Grammar School. In 1897 he came to England and entered Dulwich College the following year. He joined the Royal Military Academy, Woolwich, in September 1901 and passed out fifth, two years later, gaining prizes for chemistry and military topography. He was gazetted Second Lieutenant in the Royal Engineers on 15th July 1903, and after spending two years at Chatham came to India and was appointed Garrison Engineer at Jhansi. He joined the Survey of India as an Assistant Superintendent 2nd Grade on 11th January 1908, and served with Nos. 2, 6 and 11 Parties, in Poona, Bangalore and Burma.

In 1912, he was on deputation as Survey Officer with the Abor Expedition, being employed on minor triangulation and receiving the medal with clasp. In the following year Lieut. Field became Officer in charge of the Surveyor General's office at Calcutta, where he successfully undertook the laborious work of rewriting the General Handbook of the Survey of India.

Lieut. Field had a great capacity for perfecting himself in different branches of sport. When he came to India he did not excel at games and was not fond of riding. By taking pains and by constant practice, he became a very proficient horseman, a good shot, and a fine tennis player.

Lieut. Field was promoted Captain in July 1914 and on reversion to military duty on 22nd October, sailed for England and was employed at Colchester training the sappers of the new armies. He proceeded to France in July 1915 with the 79th Field Company, R.E., and after being stationed at Albert and Bray assumed command of the 92nd Field Company. He was actively engaged during the Somme offensive in 1916, and on the evening of 13th July was killed by a shell while consolidating a position in Trones wood. He was buried in the Military Cemetery at the north end of Bray-sur-Somme near his old camp.

CAPTAIN G. F. T. OAKES, R.E.

George Frederick Thomas Oakes was born on 11th February 1883. He was educated at Dulwich College and after his two years at the Royal Military Academy was gazetted a Second Lieutenant in the Royal Engineers on 21st December 1901. In the Military Works Services, which he joined in 1904, he was stationed as Garrison Engineer at Belgaum, and officiated as C.R.E. at that place for a short period in the following year. He was appointed an Assistant Superintendent in the Survey of India on 2nd March 1907, and served with No. 15 Party in Balūchistān, and afterwards with the Triangulation Party. In 1909 he was stationed at Calcutta and Dehra Dūn, and the following year joined No. 12 Party in Assam.

Lieut. Oakes was on service with the Abor Expeditionary Force from 20th September 1911 to 4th April 1912 during which he accompanied the flank column, and was afterwards employed on the exploration of the Yamne river. He was again on deputation with the Abor Survey Detachment from 24th October 1912 to 9th August 1913, during which he was mainly engaged on the triangulation and detail survey of the Dihāng river. He was mentioned in despatches for his services in the Abor campaign, received the medal and clasp, and was promoted Captain on 21st December 1912.

He was stationed at Mussoorie in charge of No. 14 Party at the outbreak of war, but was reverted to military duty on 22nd October and sailed in the s/s. "*Multan*", for England, which he reached on 14th November. He was posted to the 77th Field Company R.E., then under training with the 17th Division at Wareham, and crossed to France with this company on 14th July 1915. After seeing service with this unit Captain Oakes was given command of the 130th Field Company R.E., of the 25th Division. It was while encouraging his men to complete their work at Ovilliers-la-Boiselle on the Somme front that he was mortally wounded by a sniper on the early morning of the 15th July 1916. He was removed to No. 36 Casualty Clearing Station where he died a few hours afterwards. He was buried in the Cimetière du Bois at Heilly, 2½ miles north of Corbie.

Captain Oakes was a good mathematician, and held charge of the Computing Party at Dehra Dūn. He was a devout Christian and a keen officer, as those who knew him can testify. He was also a keen zoologist and made a fine collection of land Mollusca, among which were some rare species, and which were worked out in detail by Colonel Godwin-Austen, F.R.S. On this death his C.R.E. wrote: "I can truthfully say that no more hardworking and conscientious officer ever lived, and his loss is a heavy blow to us all".

CAPTAIN E. C. BAKER, R.E.

Edward Carlton Baker was born in Canada on 1st January 1880, and after passing first out of Kingston Military College, was gazetted a Second Lieutenant in the Royal Engineers on the 25th June 1900. Being posted to the Indian Establishment on 5th September 1902, he served in the Military Works Department at Mian Mīr, Abbottābād, Kohāt, Peshāwar, and in the Kurram valley. He joined the Survey of India as an Assistant Superintendent, 2nd grade, on 12th January 1906, and spent the greater part of his service in the Northern Circle, largely on the N.W. Frontier. Lieut. Baker served as Survey Officer with the Mohmand Field Force from 25th April to 4th June 1908, and was successively in charge of Nos. 9, 12, and 11 parties, taking the latter party to Burma in 1910. He was promoted Captain on 25th June 1910. In 1912 he was posted to the Southern Circle with Headquarters at Bangalore, at which place he was stationed at the outbreak of war.

Captain Baker was reverted to military duty on 22nd October 1914 and proceeded to England on the s/s. "*Multan*". He was posted

to the command of a field company in the 41st Division at Aldershot until April 1916, when he proceeded to France. He was severely wounded in action on the Somme on 15th September, and died of his wounds four days later.

Captain Baker was an able and resourceful Survey officer, and was liked and trusted by all who knew him, having a high character, a cheerful and courageous spirit and a remarkably powerful physique. He was a keen Rugby footballer, and played for Blackheath during his period of Service at Chatham. He was married at Mussoorie in 1909 to Miss Elsie Johnston. Colonel W.M. Coldstream, who was C.R.E. of the 41st Division, with which Captain Baker was killed, wrote of him as "the pattern of what a Field Company Commander should be".

BREVET MAJOR (temp. LT.-COL.) A. A. CHASE, D.S.O., R.E.

Archibald Alderman Chase was born on 16th September 1884, and was educated at Bedford. He was gazetted Second Lieutenant in the Royal Engineers on 29th July 1904. On being posted to the Indian Establishment two years later, he joined the Military Works Services, being stationed successively at Calcutta and Ishapur. During the winter of 1906 he was also attached to No. 5 Company, 1st P. W. O. Sappers and Miners.

Lieut. Chase joined the Survey of India as an Assistant Superintendent on 22nd June 1908, and for the greater part of his survey career was in the Northern Circle. In 1912 he pushed through urgent surveys required for the new capital at Delhi with great success, and was then placed on special duty in connection with the Nepāl Boundary Survey from 1st January to 31st March 1913. During the following winter he was attached to the Sappers and Miners, experimenting with a light field litho press and organizing a map reproducing section for active service.

On the outbreak of war, Lieut. Chase was stationed at Mussoorie, but was reverted to military duty on 16th October 1914, and sailed at once for Marseilles, as Assistant Field Engineer to the Indian Cavalry Division Headquarters. He was promoted Captain on 30th October, and was appointed Survey officer to the Indian Cavalry Corps in November 1914, and to the 1st Indian Field Squadron, of the 1st Indian Cavalry Division in January 1915. Under Major W. H. Evans, R.E., he was employed during January, February and March on front line work at Festubert and on back line work in the Forêt de la Nieppe. The 1st Field Squadron was finally formed in April, Captain Chase being in command of No. 1 Troop.

In May 1915 Captain Chase was engaged with the 2nd Field Troop in the Ypres sector, where he did very fine work at Hooge during the attack. For his services here, he was mentioned in despatches and awarded the D.S.O. The squadron was afterwards employed dismounted in the front line trenches at Railway Wood in the Salient, and in June and July in trench work with the Indian Corps near Rue Tilleloy and Neuve Chapelle. From August to October, the cavalry were in trenches at Thiepval, after which they were withdrawn to back billets,

Captain Chase being lent to the 18th Infantry Division, where he secured very little rest.

Captain Chase seemed to thrive on front line work, for he was rarely out of the trenches. He transferred into the 18th Infantry Division in February 1916, being first given command of a R.E. Field Company, and afterwards becoming an acting Lieut.-Colonel in command of the Divisional Pioneer Battalion (Royal Sussex Regiment). Throughout 1916 and the early part of 1917, to the date of his death, he did exceptionally fine work.

Lieut.-Col. Chase was mentioned three times in despatches, and was awarded a brevet-majority, besides gaining the D.S.O. as recorded above. In March 1917 while in command of his battalion he was going round his trenches at Irles on the Somme with his C.R.E., Lieut.-Col. Henderson, when he was mortally wounded by a shell. He died of his wounds on the 11th March 1917, and was buried near Albert.

Lieut.-Col. Chase was a very fine and gallant character, and an officer who imbued all ranks serving under him with his own restless energy. In France he was thought of very highly by his divisional general, and there is little doubt that if had lived he would have received command of a brigade in a very short time.

Lieut.-Col. Chase was married in 1911 to Miss Gladys Waller and left a widow and two children.

CAPTAIN W. P. HALES, M.B.E., I.A.R.O.

Walter Percy Hales was born on 22nd July 1889 and joined the Survey of India as a Sub-Assistant Superintendent on 1st November 1907. During his service in the department he was employed almost entirely on topographical surveys, in the Northern and Eastern Circles.

Early in 1915, when civil officers in the Indian Government Service were permitted to join the Indian Army Reserve of Officers, Mr. Hales applied for a commission and was posted as Second Lieutenant to the 124th D.C.O. Baluchistan Infantry at Quetta on 19th June. On 2nd March the following year he proceeded on active service to Būshire in the Persian Gulf as a company officer of the same unit. From here he accompanied the right wing of his regiment under Lieut-Colonel E. F. Twigg to join the British Mission at Bandar Abbās. He was with Sir Percy Sykes throughout his tours in Southern Persia, holding an appointment as a temporary S. & T. officer from May 1916 to May 1918, in addition to fulfilling his regimental duties. From the latter date he was promoted to the acting rank of captain.

Captain Hales died of influenza on 1st November 1918, at Firūzābād, where he was cremated; his ashes were brought to Shīrāz, and buried there. He was appointed to be a Member of the Order of the British Empire from the 3rd June 1919, after his death, and was mentioned in Despatches in the Supplement to the London Gazette dated 20th January 1920.

APPENDICES

APPENDIX I. OUTTURNS OF SURVEY

(*a*) APPROXIMATE AREAS TRIANGULATED AND SURVEYED ON HALF-INCH OR LARGER SCALES.

Place	Period	Outturns in sq. miles	Remarks
Mesopotamia, West and N.W. Persia.	December 1914—July 1920.	117,300	Chapters 1-5, 7, 9, 10
S.W. Persia.	October 1918—April 1920.	16,060	Chapter 8.
East & N.E. Persia.	October 1918—July 1920.	45,000	Chapter 11.
Macedonia (Indian detachment only).	November 1917—March 1919	1,040	Chapter 12.
	Total ...	179,400	Square miles.

(*b*) RAPID RECONNAISSANCES AND ROUTE SURVEYS.

		Sq. miles	Linear miles	
Kurdistān.	January—April 1919	3000	...	Chap. 6
Upper Euphrates & Syrian desert.	March—April 1919	...	540	
South Persia.	November 1916—March 1917.	...	1300	Chap. 8
Northeast Persia.	August 1919—July 1920.	4000	...	Chap. 11
East Africa.	August 1918—November 1918.	...	460	Chap. 14
	Totals ...	7000	2300	

(*c*) Large scale surveys and compilations of military positions, cantonments, etc., and of the principal cities of Persia and Mesopotamia were made and reproduced during the period under review by the various Survey of India organizations.

(*d*) These outturns do not include any work done in India during the period under review. Such work has been recorded in the Annual General Reports of the Survey of India.

APPENDIX II

MAPS AND PLANS COMPILED AND PRINTED BY MAP COMPILATION SECTION, G.H.Q., M.E.F., JUNE 1916—NOVEMBER 1918.

Description	Compiled from			Printed in				Area of Mapping in Square miles.	
	Air-photos	Survey & other sources	Total compiled & drawn	Black	2 Colours	3 Colours	4 Colours & more	From Air-photos	From other sources
Maps: Various Scales	...	28	28	25,483	1,025	300	...	...	32,540
¼ Inch Scale	...	25	25	19,404	39,758	11,100	3,800	86	71,622
½ " "	...	20	20	1,032	11,298	17,200	...	138	10,992
1 " "	32	75	107	71,548	53,874	101,568	...	1,025	14,763
3 " "	64	66	127	85,839	43,862	10,050	...	896	1,197
6 " "	15	19	34	37,132	1,475	...	...	110	71
12 " "	3	1	4	1,128	725	...	...	8	2
Applique slips, diagrams, and plans	6	99	231	192,773	112,630	82,437	6,000	...	10,533
	120	333	576	434,339	264,647	222,655	9,800	2,263	141,720

Grand total printed, 931,441. Total area of country mapped on various scales 103,840 Sq. miles. Total pulls, 1,491,540.

APPENDIX III. CASUALTIES

During the period covered by this history 10 officers, 3 surveyors, one printer and 44 khalasis were killed in action or died on service on various fronts. Their names are given in the frontispiece of this volume.

The following officers sustained wounds in action :—

Browne, C.M.	Morshead, H.T.
Coldstream, W.M.	Nosworthy, F.P. (3 times).
Couchman, H.J.	Pye, K.W.
Fitzpatrick, J.O'C.	Roome, H.E.
Hunter, F.F.	Tandy, M.O'C.
Lewis, C.G.	Tresham, C.H. (twice).
Mason, K.	

Major G.A. Beazeley was shot down while flying behind the enemy's lines and taken prisoner, while Muhammad Khan and Badan Khan were made prisoners on the Fall of Kut.

Jemadars Jagannath, Farman Ali, Tula Ram, Purdil Khan and Amar Singh were made prisoners by the Kurds for a short time in 1919 (see pp. 51, 52). Sayyid Razi Hasan died in hospital at Karachi as the result of illness contracted on active service in Mesopotamia (p. 51).

APPENDIX IV. HONOURS AND AWARDS

During the period covered by this report, the honours and awards for war services conferred on officers and men of the Survey of India consist of the following :—

(*a*) COMPANIONS OF THE ORDER OF ST. MICHAEL AND ST. GEORGE 2
Browne, C.M.
Pirrie F.W.

(*b*) COMPANIONS OF THE ORDER OF THE INDIAN EMPIRE..... 2
Pirrie, F.W.
Rich, E.T.

(*c*) PROMOTED BREVET-COLONEL..... 1
Pirrie, F.W.

(*d*) PROMOTED BREVET-LIEUT-COLONEL 6
Browne, C.M. McHarg, A.A.
Gunter, C.P. Phillimore, R.H.
Hamilton, S.W.S. Wood, H.

(*e*) PROMOTED BREVET-MAJOR..... 4
Chase, A.A. Mason, K.
Lewis, C.G. Nosworthy, F.P.

(*f*) COMPANION OF THE ORDER OF THE BRITISH EMPIRE..... 1
Ferrier, T.A.

(*g*) AWARDED BARS TO THE DISTINGUISHED SERVICE ORDER..... 2
Hamilton, S.W.S.
Nosworthy, F.P.

(*h*) COMPANIONS OF THE DISTINGUISHED SERVICE ORDER ... 14
Beazeley, G.A. Hunter, F.F. Phillimore, R.H.
Campbell J.D. Macleod, M.N. Pye, K.W.
Chase, A.A. McHarg, A.A. Tandy, M.O'C.
Couchman, H.J. Morshead, H.T. Thomas, R.H.
Hamilton, S.W.S. Nosworthy, F.P.

(*i*) OFFICERS OF THE ORDER OF THE BRITISH EMPIRE..... 4
Gunter, C.P. Tandy, M.O'C.
Kenny, P.A.T. Wauchope, R.S.

(*j*) MEMBERS OF THE ORDER OF THE BRITISH EMPIRE..... 9
Arbery, J. Kenny, P.A.T. Rennick, D.K.
Booth, A.J. McCraken, J. Strong, W.H.
Hales, W.P. Norman, G.A. Williams, L.

(*k*) AWARDED A BAR TO THE MILITARY CROSS..... 1
Nosworthy, F.P.

(*l*) AWARDED THE MILITARY CROSS..... 6
Couchman, H.J. Nosworthy, F.P.
Macleod, M.N. Perry, W.E.
Mason, K. Roome, H.E.

(*m*) AWARDED THE DISTINGUISHED CONDUCT MEDAL..... 2
Drake. A.J.A.
O' Sullivan, E.C.

(*n*) AWARDED THE INDIAN DISTINGUISHED SERVICE MEDAL..... 4
Laltan Khan Muhammad Abdul Azim
Ghulam Rasul Khan Muhammad Nasir Khan

(*o*) AWARDED COMMISSIONS FOR SERVICE IN THE FIELD..... 2
Drake, A.J.A.
Tresham, C.H.

(*p*) BROUGHT TO THE NOTICE OF THE SECRETARY OF STATE FOR WAR..... 3
Gildea, R.B.
Grant F.H.
Mansab Khan

(*q*) BROUGHT TO THE NOTICE OF THE GOVERNMENT OF INDIA..... 10
Arbery, J.
Burrard, S.G.
Colquhoun, S.
Ferrier, T.A.
Graham, R.
Greiff, J.O.
Ryder, C.H.D.
Smith, W.
Turner, H.H.
Woodhouse, S.

(*r*) MENTIONED IN DESPATCHES..... 99

Abdul Latif Khan	(1)	Jalil-ul-Kadr	(1)	Perry, W.E.	(1)
Ahmad Shah	(1)	Jamna Prasad	(1)	Phillimore, R.H.	(4)
Ananta Krishna Ray	(1)	Kenny, P.A.T.	(1)	Pirrie, F.W.	(6)
Baker, E.C.	(1)	Khitab Gul	(1)	Puri, N.C.	(1)
Beazeley, G.A.	(3)	Laltan Khan	(3)	Pye, K.W.	(1)
Booth, A.J.	(2)	Lewis, C.G.	(1)	Rennick, D.K.	(1)
Browne, C.M.	(5)	Macleod, M.N.	(2)	Rich, E.T.	(1)
Campbell, J.D.	(1)	Mason, K.	(3)	Roome, H.E.	(1)
Cardew, E.B.	(1)	McCraken, J.	(1)	Ryder, C.H.D.	(1)
Chase, A.A.	(3)	McHarg, A.A.	(1)	Sexton, C.B.	(1)
Couchman, H.J.	(2)	Mir Abdullah	(1)	Sijawal Khan	(1)
Cowie, H.McC.	(2)	Morshead, H.T.	(2)	Simons, H.B.	(1)
Francis, A.	(1)	Morton, V.W.	(1)	Strong, W.H.	(1)
Ghosh, A.P.	(1)	Md. Abdul Azim	(1)	Tandy, M.O'C.	(3)
Ghulam Rasul Khan	(1)	Muhammad Hasan	(2)	Thomas, R.H.	(1)
Gunter, C.P.	(2)	Md. Husain Khan	(1)	Tresham, C.H.	(1)
Hales, W.P.	(1)	Muhammad Khan	(1)	Turner, H.H.	(1)
Hamilton, S.W.S.	(2)	Md. Nasir Khan	(1)	Vandyke, F.R.	(1)
Hamid Gul	(2)	Nosworthy, F.P.	(6)	Wauchope, R.S.	(2)
Hunter, F.F.	(1)	Oakes, G.F.T.	(1)	Wood H.	(3)

(*s*) AWARDED CROSS OF THE LEGION OF HONOUR..... 1
Browne, C.M.

(*t*) AWARDED THE MEDAILLE D'HONNEUR..... 1
Phillimore, R.H.

(*u*) AWARDED THE CROIX DE GUERRE..... 4
Hunter, F.F.
McInnes, C.S.
Nosworthy, F.P.
Thomas, R.H.

(*v*) AWARDED THE ORDER OF ST. ANNE..... 2
Browne, C.M. (2nd Class).
Hamid Gul (3rd Class).

(*w*) AWARDED THE ORDER OF ST. STANISLAUS..... 1
McHarg, A A.

(*x*) AWARDED THE ORDER OF THE WHITE EAGLE..... 1
Wood, H.

(*y*) AWARDED THE PERSIAN MEDAL OF VALOUR..... 1
Hunter, F.F.

PERSONAL INDEX

PERSONAL INDEX

The following lists are grouped in five classes, in accordance with the pre-war organization of the Survey of India, viz: Imperial, Special, Provincial, Upper and Lower Subordinate Services. The Imperial Service is again subdivided into four groups: pre-war officers, re-employed pre-war officers, officers who joined between 1914 and 1920, and post-1920 officers. Every Imperial Officer is included in these lists, since almost all were connected with the war. In the other four classes only those officers and men who were actually on service or won distinction through war work between 1914 and 1920 are included. Every endeavour has been made to secure accuracy, but the available records are in some cases incomplete, particularly as regards the purely military services rendered; some of the theatres of war of certain individuals and a few names of Lower Subordinates may have been omitted. In the case of pre-war Imperial Officers, the pre-war rank is given first, with the status on July 1st 1925 shown in brackets. Officers and men who had left the department prior to this date are shown in italics. The following abbreviations are used:—

Ad. = Aden; E. Af. = East Africa; Bk. Sea = Black Sea; Bur. = Burma, (Kachin Rebellion and Kuki operations); Eg. = Egypt; Gall. = Gallipoli; It. = Italy; Mac. = Macedonia; Mes. = Mesopotamia, (includes Kurdistān); N.W.F. = Northwest Frontier of India, (includes Afghān war, and Wazīristān Campaign to 1920); Pal. = Palestine; Pers. = Persia; Russ. = Russia; Sin. = Sinai; Syr. = Syria; T. Casp. = Trans-Caspian; W.F. = Western Front.

The figures refer to pages of this volume.

I. IMPERIAL SERVICE (NOW CLASS I.)

(a) Pre-War.

[1] S. of I. Notes, July 1925. [2] S. of I. Notes, Sept. 1919.

[3] *Bythell, Col. W.J.*, R.E., Employed during the war in India and England.
Campbell, Capt. J.D., R.E., (MAJ., D.S.O.) Eg., Sin., Pal. 99-104. 128. 129.
Cardew, Capt. E.B., R.E., (CAPT.) Roll of Honour, W.F. 117. 129.
Chase, Lieut. A.A., R.E., (TEMP. LT.-COL., D.S.O.) Roll of Honour, W.F. 121. 128. 129.
[4] *Coldstream, Major W.M.*, R.E., (COL.) W.F. 127.
Cotter, Capt. V.R., I.A., (MAJOR) N.W.F.
Couchman, Capt. H.J., R.E., (MAJOR, D.S.O., M.C.) W.F. 127. 128. 129.
Cowie, Major H.McC., R.E., (LIEUT.-COL.) Mes., N.W.F. 66. 109. 129.
[5] *Crichton, Lt.-Col. R.T.*, C.I.E., I.A., (LIEUT.-COL.) Employed in India. 56.
[6] *Crosthwait, Major H.L.*, R.E., (LIEUT.-COL., C.I.E.) E.Pers., N.W.F. 85. 86.
Crosthwait, Capt. L.G., I.A., (MAJOR) N.W.F., Mes. 37. 58.
Field, Lieut. J.A., R.E., (CAPT.) Roll of Honour, W.F. 119.
Foster, Capt. R., I.A., (MAJOR) N.W.F.
Gunter, Major C.P., R.E., (LT.-COL., O.B.E.) Mes. viii. x. 18. 19. 21. 24-26. 29. 37. 44. 51. 128. 129.
Gwyn, Capt. A.H., I.A., (MAJOR) Mes. 26.
Hamilton, Capt. S.W.S., R.E., (BT.-LT.-COL., D.S.O.) W.F. 128. 129.
Huddleston, Lieut. P.G., R.E., (CAPT.) Roll of Honour, W.F. 118.
Hunter, Capt. F.F., I.A., (MAJOR, D.S.O.) Gall., N.Pers. 127. 128. 129.
Hunter, J. de G., M.A., (SC.D.,) Mes., W.Pers. viii. 25. 31. 34-36. 40. 51-53. 79.
King, Lieut. F.J.M., R.E., (MAJOR) W.F.
[7] *Lenox-Conyngham, Lieut.-Col. G.P.*, R.E., (COL. SIR, F.R.S.) Mes. xi. 37.
Lewis, Lieut. C.G., R.E., (MAJOR) W.F., Mes., N.W.F. viii. 26. 38. 44-49. 109 37. 110. 127. 128. 129.
MacLeod, Capt. M.N., R.E., (LIEUT.-COL., D.S.O., M.C.) W.F. 128. 129.
Mason, Lieut. K., R.E., (MAJOR, M.C.) W.F., Mes., W.Pers. vii. viii. ix. 11. 12. 18. 38-41. 43. 48-50. 127. 128. 129.
McHarg, Major A.A., R.E., (LT.-COL., D.S.O.) E.Af. ix. 128. 129.
McKay, Lieut. H.M., R.E., (CAPT.) Roll of Honour, W.F. xxi. 116.
[8] *Mears, Maj. A.*, I.A., (LIEUT.-COL.) Employed in India.
Morshead, Capt. H.T., R.E., (MAJOR, D.S.O.) W.F., N.W.F. 127.128. 129.
Nosworthy, Lieut. F.P., R.E., (BT.-LT.-COL., D.S.O., M.C.) W.F. 127. 128. 129.
Oakes, Capt. G.F.T., R.E., (CAPT.) Roll of Honour, W.F. 119. 129.
Perry, Lieut. W.E., R.E., (MAJOR, M.C.) Mes., W.Pers. viii. 6. 8. 14. 22. 24. 25. 27. 29. 31. 66-75. 77. 82. 128. 129.
Phillimore, Capt. R.H., R.E., (BT.-LT.-COL., D.S.O.) W.F., Mac. 94-96. 128. 129.
[9] *Pirrie, Lieut.-Col. F.W.*, I.A., (COL., C.M.G., C.I.E.) Mes. viii. ix. xxv. 1-6. 9. 13-16. 19. 21. 22. 24.25. 27-30. 32. 33. 51. 54-56. 128. 129.
Pye, Capt. K.W., R.E., (MAJOR, D.S.O.) W.F. 127. 128. 129.
[10] *Renny-Tailyour, Col. T.F.B.*, C.S.I., R.E., (COL.) Employed in India.
Rich, Major E.T., R.E., (Lt.-COL., C.I.E.) S.Pers., N.W.Pers., Bur., S. Russ. Mes., viii. 61-63. 77-82. 128. 129.

[3] S. of I. Notes, July 1916.
[4] " " Aug. 1924.
[5] " " March 1920.
[6] " " June 1923.
[7] S. of I. Notes, Oct. 1921.
[8] " " Feb. 1921.
[9] " " June 1922.
[10] " " March 1920.

[11] *Robertson, Lieut.-Col. C.L.*, C.M.G., R.E., (LT.-COL.) Employed in India.
Roome, Lieut. H.E., R.E., (MAJOR, M.C.) W.F., Mes., W.Pers., N.W.F., 127. 128. 129.
[12] *Ryder, Lieut.-Col. C.H.D.*, D.S.O., R.E., (COL., C.B., C.I.E.) Surveyor General, Mes. xi. xxi. 1. 3. 37. 41. 83. 129.
Scott, Capt. F.B., I.A., (MAJOR) Ad., N.W.F.
Tandy, Major E.A., R.E., (COLONEL COMMANDANT, SURVEYOR GENERAL) Mes. xii.
Tandy, Major M.O'C., R.E., (LT.-COL., D.S.O. O.B.E.,) W.F., Mes., N.W.F. 127. 128. 129.
Thomas, Capt. R.H., R.E., (LT.-COL., D.S.O.) W.F. 128. 129.
Thompson, Capt. C.M., I.A., (MAJOR) Employed in India
Thuillier, Capt. L.C., I.A., (LT.-COL.) Mes. 25. 31. 35.
Trenchard, Capt. O.H.B., R.E, (MAJOR) W.F.
[13] *Turner, Major H.H.*, R.E., (COL.) Mes. 6. 8. 10. 13. 129.
Wauchope, (Wahab), Lieut. R.S., I.A., (MAJOR, O.B.E.) N.W.F. 128. 129.
Wood, Major H., R.E., (COL.) W.F., Mac., Bk. Sea viii. xxi. 92-96. 128. 129.

(*b*) RE-EMPLOYED DURING THE WAR.

[14] *Wauhope, (Wahab), Col. R.A.*, C.B., C.M.G., C.I.E., R.E., (COL.) Ad., India xi. xxv.

(*c*) JOINED THE DEPARTMENT DURING THE PERIOD 1914-1920.

Douglas, Capt. J.K, R.E.
Glennie, Capt. E.A., D.S.O., R.E., Mes.
Jackson, Capt. L.H., I.A., E.Af., Mes.
Joly de Lotbinière, Capt. H.A., M.C., R.E., N.W.F., Mes., Pal.
Lennox, Capt. G., I.A., Mes.
Meade, Capt. H.R.C., I.A., Mes.
Penney, Capt. T.M.M., R.E., W.F., Mac., Bk.Sea, E.Pers.
Slater, Capt. O., M.C., R.E., Mes, T.Casp., E.Pers., N.W.F.
Wheeler, Bt.-Major E.O., M.C., R.E., W.F., Mes.

(*d*) JOINED THE DEPARTMENT SINCE 1920.

Angwin, Lieut. J.B.P., R.E.
Bazley, Lieut. H.A., R.E.
Bomford, Lieut. G., R.E., W.F., N.W.F.
Crone, Lieut. D.R., R.E.
Gemmell, Capt. G.W., I.A., Mes.
Haycraft, Capt. T.W.R., R.E., W.F.
Heaney, Lieut. G.F., R.E., W.F.
Mac Ivor, Capt. R.S.P., I.A., E.Af.
Norman, Capt. W.J., M.C., R.E., W.F., Mac.
Osmaston, Lieut. G.H., R.E., W.F., N.W.F.

[11] S. of I. Notes, Sept. 1921.
[12] " " Sept. 1924.
[13] S. of I. Notes, Sept. 1922.
[14] " " Feb. 1921.

II. SPECIAL, TECHNICAL, AND MINISTERIAL APPOINTMENTS

Arbery, Hon. Major J., M.B.E., 128. 129.
Ferrier, T.A. C.B.E., xi. 128. 129.
Graham, Hon. Lieut. R. 129.
Smith, Hon. Lieut. W., M.B.E. 129.
Woodhouse, S., xi. 119.

Colquhoun, S., 129.
Davis, Sergt. P., late R.E., Mes.
Mahoney, Capt. B. C., W. F.
Oddy, C.F., Mes., N.W.F. 37. 109. 111.
Thomas, G.
Vandyke, F.R., Mes. 129.

III. PROVINCIAL SERVICE (NOW CLASS II)

Booth, A.J., M.B.E, Mes. 8. 14-16. 22. 25. 27. 28. 30. 31. 34-36. 53. 57. 128. 129.
Calvert, Capt. F.E.R., Mes. x.
Calvert, J.A., N.W.F. 109. 110.
Chuckerbutty, N.N., L.C.E., Mes.
Collins, Lieut. V.D.B., Roll of Honour, W.F. x. xxi. 117.
Cooper, G.E.R., E.Pers., N.W.F. 85.
Dickson, Lieut. A.V., N.W.F. x.
Drake, Lieut. A.J.A., D.C.M., E. Af. x. 105-108. 128. 129.
Duni Chand Puri, N.W.F.
Fielding, S.S.McA., Mes. 25. 31. 34.
Fitz-Gibbon, Capt. L.B., Mes., N.W.F. x. 56.
Fitzpatrick, Capt. J.O'C., W.F., Pal. x. 127.
Gildea, Lieut. R.B., Ad. x. 129.
Grant, F.H., E. Af., S.Pers. x. 63-65. 129.
Greiff, J.O., Employed in India. 129.
Grice, F.J., E. Af., E.Pers., N.W.F. x. 85. 111.
Hales, Lieut. W.P., M.B.E., Roll of Honour, S.Pers. x. 122. 128. 129.
Hanson, R.C., N.W.F. 109.
Hughes, H. T., Bur.
Kenny, P.A.T., O.B.E. N.W.F., E.Pers., 85. 86. 128. 129.
Kitchen, F.B., Mes. 25. 31. 34. 35. 52-54.
Luxa, D.H., Mes. 37.
McCraken, J., M.B.E., Mes. 4. 6. 8. 13. 15. 16. 22. 25. 27. 37. 128. 129.
McInnes, Lieut. C.S., W.F. x. xxi. 129.
Miller, Lieut. W.J.B., W.F., Mes. x.
Moore, Lieut. A.J., x.
Morton, V.W., Mes. 57. 129.
Murphy, A.F., S. Pers., Mes. 35. 36. 53. 62. 63.
Newland, B.C., Mes. 35. 58.

IV. UPPER SUBORDINATE SERVICE

(*a*) Pre-War.

(*b*) Promoted during the War, 1914-20.

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[1] S. of I. Notes, Sept. 1923.
[2] Since promoted to class II.
[3] S. of I. Notes, July 1925.

Muhammad Khan, C.H., Mes. 12. 127. 129.
[4] Ram Prasad (Pershad) C.H., *Rai Sahib*, E.Af., Bur. 105-107.
Sadik Ali, C.H., Mes., N.W.F. 111.
Shib Lal, C.H., *Rai Sahib*, E.Pers., N.W.F. 85. 111.

(*c*) PROMOTED SINCE 1920.

Abdul Aziz Khan, Mes., Pers., 62.
Amrit Ram, E.Af., Bur. 105-107.
Banerjea, H.C., B.A., Mes. 25.
[5] Gulab Singh, Mes., W.Pers. 66. 74.
Jagannath, Mes. 51-53. 127.
Kar, Hiranya Kumar, Mes.
Khan Muhammad, C.H., Mes. 54.
Lalbir Singh, E.Pers., N.W.F.
Latif Khan, C.H., I.D.S.M., E.Pers., N.W.F.
Muhammad Siddik, Bur.
Shadi Lal Dube, Mes.
Sijawal Khan, C.H., Mes., N.W.F. 16. 22. 109. 129.
U.Pe, A.T.M., Bur.

V. LOWER SUBORDINATE SERVICE

(SURVEYORS, CLERKS, DRAFTSMEN ETC.,).

Abdul Ahad Khan, Mes.
Abdul Aziz, Mes.
Abdul Hamid, Mes.
Abdul Jalil, Mes.
Abdul Wahab, Mes.
Abinash Chandra Hajra, Mes.
Adalat Khan, S.Pers. 62.
Ahmad Shah, Mes., N.W.F. 129.
Ali Akbar, W.Pers., N.W.Pers. 66. 77. 81.
Amar Singh, Mes. xi. 51. 52. 127.
Ambica Charan Chaterji, Mes.
Amir-ud-din Ahmad, E. Pers.
Andrew Ghazi, Mes.
Arjun Singh, Mes.
Arunodya Mukerji, Mes.
Atar Singh, N.W.F.
Badan Khan, Mes. 1. 12. 127.
Bagh Singh, E.Pers.
Bajrang Bali, Mes.
Bal Krishna, Mes., E.Pers.
Barendra Nath Ghosh, Mes.
Bidya Datta, E. Pers.
Biswas, Mes.

[4] Official spelling *Prasad*.
[5] Since reverted to L.S.S.

Madhab, Mes.
Mahesha Nand, Mes.
Mansab Khan, C.H., S.W. Pers. 129.
Mariadas, Mac. 96.
Maya Datta, E. Pers.
Mazhar-ul-Hasan, Mes.
Mir Abdullah, C.H. Mes., N.W.Pers. 77. 78. 129.
Mis Was, Mes.
Mohkam Chand, Mac. 93.
Mohkam Singh, Mes.
Mohun Ram, Mac. 96.
Muhd. Abdullah, E. Pers.
Muhd. Abdul Azim, I D.M.S, C.H., Mac. xi. 93. 95. 97. 128. 129.
Muhd. Abdul Ghaffar, Mes.
Muhd. Abdul Wahid, Roll of Honour, Mes.
Muhd. Abdus Salam Siddiki, Mes. 51.
Muhd. Akbar, I. Mes.
Muhd. Akbar II. Mes., N.W.Pers. 77. 78.
Muhd. Ali, Mac. 96.
Muhd. Ayub Khan, Mes., E. Pers., N.W.F.
Muhd. Faiz-ul-Hasan, Mes.
Muhd. Hashim I, Mes.
Muhd. Hashim II, E. Pers., N.W.F.
Muhd. Ibrahim, Mes.
Muhd. Ismail Khan, Mes.
Muhd. Mustafa, Mac. 93.
Muhd. Nasir Khan, I.D.S.M. Mes. 128. 129.
Muhd. Saddik, Bur.
Muhd. Yakub Khan, E. Pers.
Muhd. Yusuf Khan, E. Af. 105.
Muhd. Wasil, Mes.
Muzaffar Husain, Mes.
Najmul Husain, S.W. Pers. 64.
Nalaraju Nayadu, Mac. 96.
Narayan Datta, N.W.F.
Narendra Nath Mukharji, Mes.
Nur Ahmad, Mes. 44. 48.
Partab Singh. N.W.F.
Pran Krishna Das, Roll of Honour, Mes.
Purdil Khan, Mes. xi. 51. 52. 127.
Rafi-ud-din, E.Pers.
Raja Ram, Mes.
Ram Chandra, E. Pers.
Ram Charan, Roll of Honour, Mac. 93. 97.
Ram Charan Bhagwan, S.W.Pers.
Ram Pyari Tiwari, Mes.
Ray, Ananta Krishna, Mes., 129.
Razi Hasan, Sayyid, Roll of Honour, Mes. 51. 127
Rup Chand, E. Pers.
Sadik Ali, Mes. N.W.F.

GENERAL INDEX

GENERAL INDEX

NAMES IN ITALICS REFER TO THOSE IN THE PERSONAL INDEX OF THE SURVEY OF INDIA, WHERE PAGE REFERENCES ARE GIVEN.

A

D.

E.

L.

M.

N.

O.

T

Geod. Br. P.O.—1926—720.

Me